Morse Memorial.

A MEMORIAL

OF

Finley Breese

SAMUEL F. B. MORSE,

FROM THE

CITY OF BOSTON.

Boston, Mass. - City Council.

c.

PRINTED BY ORDER OF THE CITY COUNCIL.

1872.

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ERRATA.

Page 14. — Twelfth line from the bottom, for "*the first*," read "*he first.*"

" 18. — Twentieth line from top, for "*this period*," read "*this point.*"

" 27. — Third line from bottom, strike out "at this distance."

" 49. — Sixteenth line from top, for "Aspinwell," read "Aspinwall."

CITY OF BOSTON.

EXECUTIVE DEPARTMENT,

CITY HALL, BOSTON, April 10th, 1872.

TO THE CITY COUNCIL: —

I have received a letter from A. S. Solomons, Esq., enclosing a copy of a resolution passed by the National Telegraph Memorial Monument Association, in honor of the memory of the late Samuel F. B. Morse, which letter and resolution I transmit herewith, and I respectfully invite your attention to the same.

WILLIAM GASTON, *Mayor*.

NATIONAL TELEGRAPH MEMORIAL MONUMENT ASSOCIATION,

WASHINGTON, D. C., April 5, 1872.

TO THE HONORABLE MAYOR OF THE CITY OF BOSTON: —

SIR, — I have the honor to transmit to you herewith a resolution adopted by this Association, inviting the co-operation of the friends and admirers of the late Professor Samuel F. B. Morse throughout the country, in holding meetings, on Tuesday evening, the 16th instant, simultaneously with a great National Memorial Meeting to be held in the House of Representatives at the National Capital.

On behalf of this Association, I respectfully and earnestly request you to take appropriate measures, at the earliest moment possible, for holding such a meeting in your city at

the time named. The telegraph wires will be freely open on the occasion for an exchange of sentiments between the several meetings and the one held here.

The favor of an early reply is requested.

Very respectfully, yours,

A. S. SOLOMONS,

Chairman of the Committee of Arrangements.

RESOLUTION.

Whereas, the United States House of Representatives has placed its hall at the disposal of the National Telegraph Memorial Monument Association, for the purpose of holding a memorial meeting in honor of the late Samuel F. B. Morse, on Tuesday, April 16th, and prominent members of both houses of Congress and other distinguished speakers have consented to address the meeting;

And, whereas, the telegraph has been freely placed at the disposal of this Association for that evening, to secure an exchange of sentiments with the meetings held in all portions of the country:

Be it resolved, That the municipal authorities of the cities of the United States are hereby invited to call meetings of similar character in their several localities on the same evening, in order that the meetings may be in telegraphic communication, and thus a simultaneous expression be given to the national grief on the occasion of this irreparable loss.

Attest: H. AMIDON, *Secretary.*

CITY OF BOSTON.

IN COMMON COUNCIL, April 11, 1872.

Ordered, That his Honor the Mayor be requested to call a meeting of the citizens of Boston in Faneuil Hall, on Tuesday evening next, the 16th inst., for the purpose of giving expression to the feelings of this community on the great loss sustained by the nation in the death of Samuel F. B. Morse.

Sent up for concurrence.

M. F. DICKINSON, JR., *President.*

IN BOARD OF ALDERMEN, April 13, 1872.

Concurred,

S. LITTLE, *Chairman.*

MEETING IN FANUEIL HALL.

In accordance with the request of the City Council, his Honor the Mayor called a meeting of the citizens in Faneuil Hall, on Tuesday evening, the 16th of April, at 7½ o'clock, "for the purpose of giving expression to the feelings of this community on the great loss sustained by the nation in the death of Samuel F. B. Morse."

The meeting was organized by the choice of the following officers: —

President. — His Honor William Gaston.

Vice-Presidents. — His Excellency William B. Washburn, William Claflin, H. H. Coolidge, Josiah Quincy, John E. Sanford, Alexander H. Rice, F. W. Lincoln, Otis Norcross, Marshall P. Wilder, Emory Washburn, John H. Clifford, J. M. Wightman, N. B. Shurtleff, Thomas Russell, George B. Upton, E. R. Mudge, Harvey Jewell, Alpheus Hardy, George S. Hillard, Professor Samuel Eliot, Professor J. D. Runkle, S. H. Walley, B. R. Curtis, William Gray, George C. Richardson, Albert Fearing, R. A. Chapman, Horace Gray, Jr., John Wells, J. D. Colt, Seth Ames, Marcus Morton, George B. Loring, Lorenzo Sabine, Homer Bartlett, Thomas Aspinwall, William Perkins, J. M. Forbes, Gardner Brewer, Nathan Carruth, Amos A. Lawrence, James L. Little, Francis Bacon, James M. Beebe, Edward Austin, J. Ingersoll Bowditch, Henry L. Pierce, Benjamin E. Bates, Benjamin T. Reed, James T. Fields, Samuel Little, M. F. Dickinson, Jr., E. S. Tobey, William B. Spooner, Charles G. Greene, Henry W. Paine, William Whiting, George Lewis, H. O. Houghton, William H. Kent, Edward Atkinson, Charles W. Slack, S. N. Stockwell,

Delano A. Goddard, Roland Worthington, George L. Ward, Joseph S. Ropes, William Parsons, Avery Plumer, J. C. Converse, Nathaniel H. Emmons, F. B. Crowninshield, N. J. Bradlee, Charles E. Jenkins, Weston Lewis, W. W. Greenough, T. C. Amory, Charles H. Allen, Samuel C. Cobb, George B. Nichols, Charles W. Wilder, Alvan Adams, R. B. Forbes, Edward Whitney, Hamilton A. Hill, Nathaniel Adams, Nathan Crowell, George B. Faunce, S. D. Warren, Nathan Matthews, Cyrus Wakefield, Nehemiah Gibson, G. W. Pope.

Secretaries. — Charles F. Wood, William G. Blanchard, John F. Kennard.

The Mayor read the resolution passed by the National Telegraph Association, and said, —

Ladies and Gentlemen, — Several distinguished citizens have consented to appear here to-night and address ycu. They are gentlemen known here and everywhere in the country, and there will, therefore, be no occasion to announce them otherwise than by their names. I will first introduce to you the Honorable Josiah Quincy.

Mr. Quincy then read the following resolutions: —

Resolved, That the City of Boston, in common with the rest of the country, and the whole civilized world, feel sensibly the loss which science has sustained in the death of Professor Morse, whose great invention has been of incalculable value to all the interests of life, and has conferred lasting honor upon his country.

Resolved, That it is peculiarly incumbent upon us to express our sense of the loss which the world has sustained in the death of the eminent benefactor of the human race, from the fact that he was born among us, and that his early training was drawn from the institutions of New England.

Charles F. Wood, Esq., the Secretary, read the following communication: —

BROOKLINE, 16th April, 1872.

DEAR MR. MAYOR, — I am sincerely sorry that a previous engagement for this evening will prevent my attendance at the meeting to which you have so kindly invited me. It would have given me peculiar satisfaction to take part in the proposed tribute to the memory of Professor Morse. I could hardly, indeed, have said much of "the loss sustained in his death." Spared, as he was, to a venerable old age, with his great work fully accomplished and universally recognized, nothing remained for him but to "put on that immortality" to which he had ever looked forward with a Christian's hope and faith. There is no loss in such a death. But the gain and the glory which the nation has derived from his life would have furnished such a subject of remark as has rarely been presented at any public commemoration.

When Professor Morse first appealed to the Government of the United States for aid in his telegraphic experiments, thirty years ago, it was my fortune, not only to be a representative in Congress from the city of Boston, but to be a member of the Committee of Commerce, to which his appeal was referred, and by which the first appropriation in his behalf was reported. I rejoice to remember that I supported that appropriation both in committee and in the House, though not a few around me were either leaving their seats to avoid the responsibility of the measure, or remaining only to deride and oppose it. Boston may thus claim to-night to have contributed at least one vote to the original success of the great enterprise.

Two years afterwards, I stood in the throng on the steps of the Capitol while the first formal messages were passing along the magic chords between Washington and Baltimore; and when the announcement of Mr. Polk's nomination for the presidency, a few seconds only after it had been decided upon by a convention forty or fifty miles off, with the tender of the vice-presidency to Mr. Silas Wright, refused in our presence as soon as made, gave us all the earliest and most vivid impression, not merely that a new kind of *wire-pulling* had entered into politics, but that a mysterious and marvellous power of the air had at length been subdued and trained to the service of mankind.

Since then, I need not say the triumphs of the electric telegraph, over land and over sea, have made themselves felt in every sphere, public and private, throughout the world, and have literally come home to every man's fortunes and fireside.

We of Massachusetts do not forget that Morse, like Franklin and Count Rumford, pursued his researches and achieved his successes far away from the place of his birth. But we cannot forget, also, that the native soil of them all is contained within the same narrow boundaries which include Lexington and Bunker Hill and Faneuil Hall.

We have thus something of a peculiar right and duty to unite in doing honor to the name and fame of Professor Morse, and to count them and cherish them among our own historical treasures.

Regretting once more my inability to be with you,

I am, dear sir,

With great respect and regard,

Yours faithfully,

ROBERT C. WINTHROP.

His Honor WILLIAM GASTON, Mayor of Boston.

The Secretary also read the following despatch: —

WASHINGTON, D. C., April 16, —7.45 P. M.

Chicago, Milwaukee, St. Paul, St. Louis, Pittsburg, Cincinnati, Indianapolis, Louisville, San Francisco, Memphis, Charleston, Savannah, Mobile, New Orleans, Montreal, Portland, Augusta, Lynn, Boston, Concord, New Haven.

The National Morse Memorial meeting is now in progress in the hall of the House of Representatives, Speaker Blaine, assisted by the Vice-President of the United States, presiding, and the governors of the several States acting as Vice-presidents, and is now ready to receive communications.

A. S. SOLOMONS, Chairman.

The president then introduced Professor Eben N. Horsford, of Cambridge, who spoke as follows: —

Mr. Mayor, — You have assigned to me the duty of presenting a sketch of Prof. Morse's connection with the invention of the electric telegraph.

To enable us fairly to appreciate what Prof. Morse did, let us briefly glance at what had been done before him. He discovered nothing in the field of frictional electricity. Its great doctrines were settled more than a century ago. He did not discover that the electrical force could be transmitted along what is called a conductor, for it was found out by Mr. Grey and Mr. Wheeler (Trumbull, 1853), that the electric shock could be transmitted through several hundred feet of wire as early as 1729; and Dr. Franklin drew lightning from the clouds; nor did he discover that the earth might be made a part of the electric circuit, for that is due to Dr. Watson, who in 1747 transmitted shocks across the Thames and the New River, the circuit being composed of one wire two miles long and two miles of earth.

Dr. Franklin performed a similar experiment in 1748. (Parton.) Franklin says, "Two iron rods about three feet long were planted just within the margin of the river on opposite sides. A thick piece of wire, with a small, round knob at its end, was fixed on the top of one of the rods, bending downwards so as to deliver commodiously the spark upon the surface of the spirit. A small wire fastened by one end to a handle of the spoon containing the spirit was carried across the river and supported in the air by the rope commonly used to hold by in drawing ferry-boats over. The other end of this wire was tied round the coating of the bottle, which being charged, the spark was delivered from the hook to the top of the rod standing in the water on that side. At the same instant the rod on the other side delivered a spark into the spoon and fired the spirit; the electric fire returning to the coating of the bottle, through the handle of the spoon and the supported wire connected with them."

Nor was he the first to employ the electrical current to transmit intelligence; signals were communicated from one apartment to another by means of the electric shock, by Lomond, in France, in 1757; by LeSage, at Geneva, in 1774; and Reusser, of Geneva, in 1794, employed the electric spark to transmit intelligence, using an arrangement of lines and spaces with strips of tin foil so

contrived that when these spaces were illuminated by the sparks, the form of the letter or figure was exhibited. The illumination of each letter or figure required a direct and return wire, and as his plan employed thirty-seven characters there were required seventy-four wires between each two stations. Similar telegraphs were devised by Salva and Betancourt, at Madrid, operating many miles in length, in 1797 and 1798. (Humboldt.)

All these employed frictional electricity, as did Ronalds, of England, in 1816, on a line eight miles in length, operating with pith balls on the faces of synchronous clocks, and Harrison G. Dyer, on the Long Island race-course, near New York, in 1827, on a line of two miles, using the current to discolor prepared paper. Up to this time the elements out of which to produce a successful telegraph had not been brought to light. The agent at command — frictional electricity — was fitful, influenced by the weather, and, at a distance, liable at times to be feeble.

The discovery of the voltaic pile, in 1800, opened up a new era for invention in telegraphy. It gave the advantage of the constant currrent of a battery over the intermitted shocks of the electrical apparatus. Soemmering, in 1809–11, employed the electric current developed by the voltaic pile to produce chemical decompositions with the evolution of visible gas; he employed thirty-five wires, each wire having the same letter or figure at either end. It would of course be possible to transmit words by producing gas bubbles at the ends of the wires, bearing in their order of succession the letters of which the words were composed.

This was not a telegraph — a *writing* at a distance. It was a *signal* apparatus; a voltaic semaphore. But it was cumbrous, time-consuming, and interesting chiefly as illustrating how early the discovery of the projectile force of the voltaic battery was recognized and applied to the production of visible chemical effects at a distance.

Schweigger proposed to reduce the great number of wires in Soemmering's apparatus to only two, and instead of a tube for the evolution of gas for each letter, a single tube, and the letter to be indicated by the number of seconds through which the evolution of hydrogen should continue. This apparatus so simplified was to be used in connection with a signal book.

There was needed further discovery. The first step in the new branch of science which was to fulfil this want was taken by the Scandinavian, Œrsted, of Copenhagen, who, in 1819, found that when the electric current passes in a direction north or south through a wire, it causes a free, magnetic needle immediately above or below it, to assume or tend to assume a position at right angles to the direction of the current, and that by reversing the direction of the current the movement of the needle may be alike reversed. In the next year Schweigger of Halle, and Poggendorff of Berlin, simultaneously discovered that the deflection of the needle may be increased by coiling an insulated wire in a series of ovals or flat rings, compactly disposed, in a loop, and conducting the current around the needle, from end to end; and produced the "galvanic multiplier," by which the deflection of the needle was much greater and more prompt. This invention was the basis of the galvanometer first used by Professor Henry.

Ampère took advantage of the discovery of Schweigger to propose a plan for a telegraph in which there was a needle for each letter. These discoveries made possible the electro-magnetic signal or semaphoric telegraph. The early telegraphs, of Schilling of St. Petersburg, of Gauss and Weber of Göttingen, and of Cooke and Wheatstone of England, were based on these discoveries. The electric current could now be made to produce *reciprocal motion*, but the force was too feeble to be used in practical recording, and the necessary devices for the production of intelligible signals were undesirably complex.

Still further discovery was required for a *registering* telegraph, and the first step in this needed direction was made by Arago, who in 1820 magnetized a straight iron bar or needle by placing it in a long spiral of wire and transmitting the galvanic current through the coil.* The second step was taken by Schweigger in the pro-

* De la Rive sent a current through a close circuit of insulated copper wire, showing that the ring produced by the current acquired singular magnetic properties. Barlow, in describing the apparatus in 1824, says, "A fine copper wire covered with silk thread is coiled five or six times and tied together so as to form a ring about an inch in diameter, and the ends of the wire are connected, by solder, one with the zinc and the other with the copper slip above the cork. When the apparatus is placed in water, slightly acidulated with sulphuric or nitric acid, the ring becomes highly magnetic, etc."

duction of the flat spiral. In 1824, Barlow gives a diagram of the volute in one plane invented by Schweigger, and says, p. 266, "The best form for the spiral, however, is that in which the wire lies all in one plane (as in Fig. 24)." (This figure exhibits a coil like the hair-spring of a watch.) "This being connected by its two extremities with the poles of the battery will take up an astonishing quantity of filings which by their reciprocal attraction toward each other exhibit the most pleasing appearance."

The next step was taken by Mr. William Sturgeon of London, in 1825. He found that by coiling copper wire loosely around a piece of insulated soft iron, bent into the form of a horseshoe, the successive coils out of contact with each other, he could convert the non-magnetic soft iron into an electro-magnet. When the current was interrupted, the soft iron ceased to be magnetic; when the current was restored, the iron became again magnetic. This gave the possibility of producing reciprocal motion.* The force thus imparted to the iron, the capacity to attract other iron and to release it when the current was interrupted, though actual, was not suited in two particulars to be used in telegraphy. It employed a quantity battery, and the length of wire connecting the battery with the magnet was inconsiderable.

At this stage of the development of electro-magnetism came in the series of brilliant experimental researches made by Professor Joseph Henry, now Secretary of the Smithsonian Institution, then residing in Albany. They were made from 1828 to 1831. Reflecting on the increased magnetic effects observed in the compact circles of insulated wire of Schweigger and De La Rive, the *first* employed the *insulated* wire of many coils to make an electro-magnet. By a covering of silk or cotton, successive coils of the wire were kept distinct and apart, so that it could be compactly wound in succcessive layers upon itself, and thus a current could be made to pass an indefinite number of times around an iron bar, and the power of the bar to attract other iron multiplied alike somewhat correspond-

* The electro-magnet of Sturgeon, with its armature, and the opening and closing of the battery circuit, and the falling and restoration of the armature, were exhibited in a course of lectures at the New York Athenæum, in 1827. These lectures were attended by the colleagues of Prof. Dana, including Prof. Morse. Depositions of Mrs. Dana and Prof. Renwick.

ingly and this with the use of a comparatively small battery. He also for the first time employed the battery of many pairs to send from a distance a current through insulated wire many times wound upon itself, around a horseshoe-shaped soft iron bar. This discovery made registering electric telegraphy possible. Barlow, of England, had observed in 1825 that the power of the galvanic current he employed diminished with the increase of distance from the battery; but Henry's researches had shown that by causing the wire to pass a great number of times around a bar of iron, it was possible to produce the physical result of motion with a feeble current at relatively great distances from its source. Barlow had employed a quantity battery. Henry employed an intensity battery.

As yet there was no practical registering electro-magnetic telegraph. But it was *possible*. Ability had been conferred to instantaneously render soft iron magnetic at a distance, when it would attract to itself other iron, and to deprive it as instantaneously of magnetism, when it would release the iron which it had previously attracted. Here was the power to produce practical, effective reciprocal motion. A pen or pencil or stylus could be moved backwards or forwards, or up and down, or alternately, from one side to the other. It remained for invention, for further research, for patience and perseverance to take these discoveries and apply them as experiment should demonstrate the necessity and practicability, and produce the working telegraph.

Fechner says, in 1829, "There is no doubt that if twenty-four different multipliers — the number of the letters — were in Leipsic, for example, and the insulated wire conducted under ground to Dresden, we should have a medium, not very costly perhaps, through which determined characters could be sent instantaneously from one to the other." He says further, in 1832, that "by the employment of a very thinly wound (insulated) copper wire, coated with silver, of which one foot in uncovered condition weighed 1.95 grains, a pile of one hundred and seven small platinum pairs would be adequate for telegraphic communications, ten geographical miles. The length of wire for such a distance both ways would require for each letter twenty miles of wire, which would involve no small outlay." Fechner also pointed out

that the "telegraphic conduction does not depend on the greatness of the pairs of plates, and the strength of the conducting fluid (quantity of electricity), but, on the contrary, on the number of the pairs of plates in the pile; and would increase in direct relation to the thickness of the wire."

Ohme's law of 1825, and Schweigger's multiplier of 1820, were here first traced out to their practical end, of a galvanic semaphore. The conditions were expressed, on which the success of the needle invention depended: — numerous pairs, a large conducting wire, multiplied convolutions of insulated wire, — all were wrapped up in these few clear sentences of Fechner before 1832.

In 1832 (from 1820–1832), Schilling of St. Petersburg devised a telegraph upon the principle of deflecting a needle.

Gauss and Weber of Göttingen, in 1833–34, caused a magnetic bar to be deflected to one side or the other at will, and produce movements which they interpreted in letters of the alphabet. Cooke and afterwards Cooke and Wheatstone of England followed in this line of experiment, and produced their needle telegraphs in 1836 and 1837.

Steinheil of Munich, in 1836, employed a magneto-electrical machine, in lectures to his classes, to produce sounds upon a series of bells of different tones, which were readily translated. Up to this time, no practical, working registering telegraph had been invented. For moderate distances the telegraph was *possible*, but had not been rendered *practicable*. Prof. Henry had remarked that the force of the current from a battery of many pairs was not sensibly diminished by transmission through a wire of one thousand and sixty feet. There remained both discovery and invention to meet the necessity, and these were the great services, as I consider them, in the labors of the life whose sunset has just passed before us.

In 1832, Prof. Samuel Finley Breese Morse was returning from France on board the packet ship Sully. Among the topics of conversation on that memorable voyage was the possibility of the practical electric telegraph in view of the recent discoveries in the departments of electricity, magnetism and galvanism. This *possibility* was recognized by electricians generally, but its *practicability* could be demonstrated only by patient and faithful experiment in the line of a well-thought-out plan. The magnitude of the diffi-

culties that lay in the way could not be *known* till they had been surmounted. During that voyage Prof. Morse became inspired with the idea of a *telegraph*,—not a signal, electric semaphore, not a needle apparatus using evanescent signals, but a *recording* electro-magnetic telegraph, and the plans and devices were made and the resolution formed by him to enter upon and prosecute the necessary experimental researches required to produce the grand result he had conceived.

Prof. Morse had in his college course attended the lectures of Professor Silliman, which were of an advanced and high order, covering especially all that was known in 1808–1810 of galvanic electricity; and also the lectures of Professor (afterward President) Day experimentally illustrated, on frictional electricity. In 1827 his college recollections were revived and his interest in these subjects renewed by his attendance on the lectures of his colleague, Prof. James Freeman Dana, in the New York Athenæum. It is clear that he believed that there was enough discovered and known *to him* to enable him to invent the registering electro-magnetic telegraph. It is clear that he exhibited diagrams illustrating his devices of apparatus, and discussed with others the combinations to produce lines and dots constituting an alphabet, which of itself *demonstrates* the *existence* in his mind of a plan of the *work* of *registration*. It may be fairly presumed that Prof. Morse, whose previous life had not been devoted to scientific pursuits, on that occasion gathered from all with whom he conversed on the subject, all they were in condition to impart. Before completing the voyage Prof. Morse had, according to his own account, worked out and committed to paper the general plan of his registering telegraph,* and before the close of the year he had made a part of the apparatus to test his plan.

If there may have been others who *might have made the invention*, it is certain that he alone at that time had the inventive talent, and the necessary measure of faith and patience of which

* It will not be doubted by any who know him that Dr. Charles T. Jackson of our city, who was a fellow-passenger on the Sully, cheerfully imparted his conviction of the possibility and practicability of the telegraph. "But the testimony to the paternity of the idea in Morse's mind, and to his acts and drawings on board the ship, is ample." (Am. Encyclopedia.) See Appendix, B.

resolution and conquest are the offspring, to accomplish it. He had the clearness of vision which enabled him to see that, in spite of any difficulties incidental to so great a new departure, there was enough positively known and certain, to insure the success of a recording telegraph to whoever would pay the price, and he had the genius to appreciate the privilege as well as the honor of the self-sacrifice with which the great gift to mankind could be purchased.

Of the progress of Prof. Morse's invention from 1832 to September, 1837, when he publicly exhibited his registering telegraph, those who are familiar with the difficulties of invention generally, can form some idea; how many devices he had tested and thrown aside the world will probably never know. He experimented at great length in the direction of a chemical telegraph, but was not satisfied with his results. His mind settled upon the idea of a *permanent visible mark* or *succession of marks upon paper* requiring pressure to make. I am not aware that at this early period he had any idea of employing as the medium of transmitting intelligence the sound, which accompanies each mark as made in the modern Morse instrument. But the principle was distinctly recognized in his application for a patent in 1838, and from this period of view his instrument was at the outset an acoustic *indicator* as well as a *recording* telegraph.

In 1835, Morse made his discovery of the *relay*, the most brilliant of all the achievements to which his name must be forever attached. It was the discovery of a means by which the current, which through distance from its source, had become feeble, could be reinforced or renewed. This discovery, according to the different objects for which it is employed, is variously known as the registering magnet, the local circuit, the marginal circuit, the repeater, etc. It made transmission from one point on a main line through indefinitely great distances, and through an indefinite number of branch lines, and to an indefinite number of way stations, and registration at all, possible and practicable, from a single act of a single operator.

It was my privilege to be shown by Prof. Morse, in 1841 (and I shall never forget the charm with which he invested the two hours he gave to me, an utter stranger), one of the instruments which illustrated his inventive genius. It resembled, in external appear-

ance, a small melodeon having a key-board on which were the letters, the figures, periods, commas, etc. These keys were levers. The ends of the levers distant from the seat of the operator were in connection with brass circular disks, upon the rims of which were prominences and depressions of unequal length, so arranged that the prominences would close, and the depressions open, the magnetic circuit, and thus magnetize and demagnetize a bar of soft iron. When magnetized, the bar of iron drew to itself one end of a lever, having an iron armature, to the other end of which a pencil or pen was attached, the point of which, by this action of the magnet, was pressed against a moving ribbon of paper; when the bar was demagnetized, the lever was restored to its original position by a spring, and the pencil lifted from the paper. It is easy to see that an arrangement of prominences and depressions, or conductors and non-conductors, on the brass circles might be so contrived that each key should produce its own particular set of lines, dots and spaces. This was the *first practical registering telegraph.** Cooke, of England, when a student of anatomy at Heidelberg, in 1836, saw the Schilling telegraph in the rooms of Professor Moncke, and conceived the idea of an improved telegraph from the exhibition which he witnessed at that time, in which the deflection of the magnetic needle was caused by the electric current. He produced in that year an instrument illustrating his plan, and afterwards associated himsel with Prof. Wheatstone, and they together invented a much more elaborate apparatus and brought it out in 1837. They employed at that time five magnetic needles and coils, and either five or six wires. Morse used only one. The telegraph of Cooke and Wheatstone, in its greatest perfection, addressed itself to the eye for the interpretation of its signals — it made no record. Morse's telegraph *recorded its message in permanent characters.*

The piano key-board of Morse and his complex devices for interrupting and closing the circuit gave place as the result of

* We may except possibly the experimental results of Steinheil, not published until 1838 (and which at the time were to Prof. Morse absolutely unknown), which made combinations of dots upon a ribbon of paper, as well as produced sounds upon series of bells. The invention never came into general use, as Steinheil abandoned his own device, and adopted Morse's in its place, as soon as it became known to him.

practical experiment before the issue of the patent to the very simple device of the single key, with which we are all familiar. The pencil and pen gave place to a stylus,—a simple, hard point resting upon a ribbon of paper moving at a uniform rate immediately over a groove. His plan from the outset contemplated a single current and circuit. After the discovery of Steinheil that what had been observed by Watson and Franklin in regard to frictional electricity—that the earth might be used for a part of the circuit—was applicable to galvanic electricity, Morse adopted the arrangement of a single line of wire between the stations.

It is not possible within the time allotted me to enumerate the inventions that have been made contributing to the perfection of the working telegraph, to the transition from the trough to the constant battery of Daniell, first brought out in 1836, and without which, or its equivalent, the telegraph would be still in its infancy, and the improvements that have been made upon it since; nor of the transition from the mercury cups to the thumb-screw of Dr. Hare and the convenient switch; nor of the sounder; or the insulators; or the paratonnerre (lightning guard); or of numerous other devices and varied forms of apparatus, covered by more than a thousand separate patents that have been taken out in Europe and in this country.

On October 3, 1837, Prof. Morse filed his caveat in the Patent Office to secure his invention. On the 7th of April, 1838, he made his application for a patent, which passed the examiner in the same year, and, on the 20th of June, 1840, was issued. The first recording telegraph was brought into practical use, May 27th, 1844, between Baltimore and Washington.

INVENTION AND SCIENTIFIC DISCOVERY.

It often happens, after the crown of success has been attained by the faithful experimentalist, that the germ of the hypothesis upon which he bestowed his thought and labor is claimed to have been entertained, at an earlier period, by some one else.

The claim alleged is for the specific scientific discovery which is said to underlie the invention. Now, scientific discoveries are of various classes and degrees of merit. There are simple facts,

which, like material gems, reward an explorer in a fruitful field, and demand little effort beyond the exercise of attention and a capacity to collect and record. There are others in which the laws of physical force and chemical composition are determined by systematic experiment. There are still others in which abstract relations are brought to light, as in mathematics; and others in which the properties conferred upon matter by organic life are the subjects of research, as in physiology. Achievements in these several fields have a certain value as an evidence of culture and a title to social consideration. There is another class in which success is sometimes rewarded by pecuniary as well as social distinction. It is the class in which the object of discovery is a device by which the forces of nature or the qualities of matter may be made to render new service to civilization.

In this class, discovery has usually, for its first step, the perception or appreciation of a want. Its next step is speculation as to the devices by which the want may be met. Then there is the production of a crude contrivance, by which to test the soundness of the speculation. Then come modifications and new trials, and ultimately what seems success. Then comes expansion of the process, approaching a working-scale. Trial on the larger plan reveals fresh imperfections; new relations appear, and new expedients have to be resorted to. The devices which, at the commencement, were distinguished on account of their complexity, are replaced by others of marked simplicity. Again success seems to be attained. Now comes the grand economy and organization of the enterprise for rendering the discovery available and useful.

The rank of the scientific discovery, or series of discoveries, which make up such an invention, is high in proportion as the intrinsic difficulties to be overcome have been great, and as the investigation and solution of the problem presented have been exhaustive; and low in proportion as the difficulties were inconsiderable, and as the investigation has been superficial and the solution defective.

It rarely happens that all the stages of an important and useful discovery of this class are presided over by one mind. More frequently the earlier and later stages fall into different hands. In this event the rewards are divided. The nearer one is to the conclusion of the series, the larger uniformly is his measure of mate-

rial return. Where all have been the offspring of one mind, the honors and pecuniary emoluments enter alike into the reward. Where the naked speculation or suggestion only can be claimed, or where a crude device merely had been proposed and success predicted, the author will be assigned a place in the world's esteem, distinguished in some degree in proportion to the clearness and details of his plans and predictions. If it be not as high as the man of suggestion sometimes deems his due, it is because the applause of mankind seems to be reserved for its heroes, — the men who have not only encountered difficulty, but made its conquest, — rather than for its men of speculation, whose influence on the well-being of the race is more transient, or, if lasting, less direct.

The common sense of the world has made a uniform and, we must believe, a just discrimination in its award of merit to him who, patiently following the lead of a conception, has brought to successful issue and recognition new agencies for advancing civilization, rather than to him who equally with the former had the same happy conception, and had it even at an earlier date, but neglected the duties nature prescribed as the condition of fruition.

"The step from the first more or less vague conception of a new truth to its conclusive demonstration is a matter of far more importance and difficulty than the happy and sometimes, to all appearances, intuitive guesses which have invariably preceded every great discovery. Newton formed a right estimate of his own claims when he ascribes his success to the patient and laborious pertinacity with which he kept fast hold of an idea until, by long thinking and varied experiment, he has proved either its truth or its falsehood." (Quarterly Review: Newton as a Scientific Discoverer.)

CLAIMS OF DISCOVERERS AND INVENTORS.

It is natural and proper when a great and useful art has been born to civilization, that all persons and especially the friends of the persons who have had a share in the production and perfection of the art should feel jealously alive to the just distribution of the honors which follow such an event.

Such honors are sometimes, not infrequently indeed, unfairly distributed. Adventitious circumstances may cause mistake.

The memory is sometimes at fault. The claims of some may be exaggerated. The just claims of others may be overlooked. It seems to be required of me, in the effort to comply with your request, that I should on this occasion discuss this matter somewhat at length, although with the chance of occasional repetition. It will serve to open up the subject, if we consider a little carefully the meaning of some of the words we use. A tele-graph is literally a *writing* at a *distance*. Strictly speaking, the earlier forms of signal apparatus were not telegraphs; they were *semaphores*, — signal-bearers.

The signal may be addressed to the eye or to the ear. If to the former it would be a visual, to the latter an acoustic semaphore. Franklin, Watson, De Luc, Cavallo, and others employed friction electricity to flash powder and fire alcohol. These experiments heralded an electric *visual* semaphore. They also rang bells by electricity, and in so doing foreshadowed an *acoustic* semaphore.

The plans of Le Sage, Lomond, Reusser, Boeckman, Salva, Betancourt and Ronalds were of the class of electric *semaphores*. That of Harrison G. Dyer approached nearly to that of an electric *telegraph*.

Voltaic semaphores belong necessarily to this century. They were only possible after the recognition of the fact that the current might be made effective at a distance by the use of the pile or battery of many pairs. Soemmering's, in 1809–11, was the first of the class, and established the fact that visible effects could be produced at a distance of 10,000 feet. (Kuhn, 1866.) His device was a visual semaphore. Bain's so-called electro-chemical plan, of 1846, was a voltaic *telegraph*. He employed a battery, but not a magnet, and wrote and printed with Morse's alphabet.

Electro-magnetic *semaphores* were possible only after the discovery of Œrsted, in 1819, and the discovery of the multiplier, in 1820, by Schweigger and Poggendorff. The first of these was projected by Ampère, but never carried out. It was a needle device. Visible signs were to be made by the deflection of a needle, the voltaic current being sent through a multiplier, or long link-shaped coil of insulated wire, within which a needle was freely suspended or supported. The next seems to have been Schilling's, made some time between 1820 and 1832, a rude copy of which, made by

Professor Moncke, of Heidelberg, awoke at a later period (1836) the inventive genius of Cooke. The next was that of Gauss and Weber, in 1833–34. Then came Cooke's in 1836, and Cooke and Wheatstone's in 1837; and at about the same time Steinheil's. These were not writing or printing instruments. They made evanescent signs, which could be observed, translated and recorded. Steinheil afterward (1837) completed a magneto-electric recording or writing telegraph; which showed that the result was possible and practicable, though not practical. Electro-magnetic *telegraphs* were not practicable before an intensity battery had been employed in connection with a distant electro-magnet, surrounded with a multiplied insulated coil. This was first actually done through a distance of 1,060 feet, in 1828–29, by Prof. Henry. This experiment made it possible that with increased power in the battery, with improvements in the magnet, and inventions of special mechanical devices, an electro-magnetic telegraph for registration at distances sufficiently great to meet the wants of the every-day world, might be devised.

The invention, however, in its most elementary condition, was not made for four years, and then without a knowledge of these experiments, nor was it brought into working condition for three more, and then at first without employing either of these essential elements, to wit, the battery of multiplied pairs, the magnet of multiplied coil, and the long conductor; and more than two years additional before a caveat was lodged, and three before a patent was granted, and still four years elapsed before the invention was in successful public service.

This delay between the discovery of a scientific truth and its application to the useful arts is not unusual.

Interval after the possibility of an invention before the invention was made.

After Winckler's experiment at Leipsic in 1744, with a Leyden jar and a long conducting wire, and Watson's experiments in 1747–8, with a circuit of two miles of wire and two of earth; and Franklin's experiments, from 1748 to 1754, exhibiting reciprocal motion, rotation of wheels, ringing of bells, firing of combustibles, etc., it was possible to produce electric signals conveying intelligence.

The first that appeared was that of Le Sage, in 1774, after an interval of twenty years; * then Reusser's, in 1794, after forty years; then Salva's, with a conducting wire of many miles, in 1796, after about forty-two years; then Betancourt's, of twenty-six miles, in 1797–98, after forty-three years; then Ronald's, in 1816, after sixty-two years; and then Harrison G. Dyar's, in 1828, after seventy-four years.

After the discovery of the pile of volta in 1800, it was possible to invent: —

Soemmering's electro-chemical semaphore, which did not appear till 1809–11, after eleven years. J. Redman Coxe's (of Philadelphia) suggestion dates 1816, after sixteen years. Bain's electro-chemical recording telegraph, which did not appear till 1846, after forty-six years.

After Œrsted's discoveries of 1819 *and* 1820, and especially of Schweigger's multiplier, constructed with insulated wire immediately after, it was possible to produce Ampère's suggestion (or invention), which appeared the same year, and he remarks that a like result had been suggested by La Place.

Schilling's invention was in progress from 1820 to 1832 — twelve years. Gauss and Weber's appeared in 1833–34 — fourteen years. Cooke and Wheatstone's in 1836–37 — sixteen years.

After Sturgeon's electro-magnet, in 1826, when an electro-magnetic recording telegraph was possible for short distances, Morse's conception came, in 1832, after six years.

After Henry's electro-magnet, wound with insulated wire in 1828, published in 1831, which made electro-magnetic telegraphy possible for increased distances, came Morse's receiving or relay battery and recording telegraph, invented in 1832, and in working condition in 1836, after an interval of five years. It was publicly exhibited in 1837, after six years; and operated between Baltimore and Washington in 1844, after thirteen years.

After Faraday's discovery of magneto-electricity, in 1831, came Steinheil's telegraph in 1837, after six years. Steinheil had demonstrated the practicability of using the earth for a part of the electro-magnetic circuit in 1838. It was not used in this country till 1845.

* Lomond's telegraph seems to have been produced as early as 1757, but only operated between one room and another.

As we have now fixed some of the more important dates and intervals, let us put on record two or three more that we need to bear in mind, — recalling that while Soemmering and Bain needed only the voltaic pile or a battery of many pairs; Schilling, Gauss and Weber, Cooke and Wheatstone needed in addition the galvanic multiplier; Morse the battery and electro-magnet, and Steinheil a magneto-electric machine.

Soemmering's voltaic semaphore preceded Schilling's needle semaphore by a dozen years and more.

In point of time, Morse's invention on the Sully preceded Cooke's at Heidelberg by four years — 1832–1836.

In point of construction and actual working, Morse preceded Cooke by a year — 1835–1836.

In point of exhibition to the public, Cooke and Wheatstone were coincident with Morse — 1837.

In point of actual use by the public, Cooke and Wheatstone preceded Morse by six years — 1838–1844.

These relations of discovery to invention and practical application may be illustrated in tabular form: —

Constant battery of Daniell, 1836, without which none would have succeeded.	Volta, 1800.	Electro-chemical semaphore. Soemmering's in 1809–11. Bain's electro-chemical telegraph in 1846.
	Œrsted, 1819. Schweigger, 1820.	Needle semaphores. Ampère's in 1820. Schilling's, 1820–1832. Gauss and Weber's in 1833–34. Cooke's in 1836. Cooke and Wheatstone's in 1837.
	Arago in 1820. Sturgeon in 1825. Henry in 1829.	Recording telegraph of Morse in 1832.
	Faraday in 1831.	Magneto-electric telegraph. Steinheil's in 1837. Wheatstone's later business alphabet semaphore.

Having thus before us the great facts in the history of the new art, we are in condition to examine more carefully into the claims to originality and priority of the discoverers and inventors.

Let us have distinct ideas in our assignment of credit. The discovery of a law, or the invention of a device, may be strictly original to two or more persons. It may be made by one in ignorance that it had been made by another before him, or the two may have been coincident in time as well as result.

Volta was alone in the invention of the pile.

Soemmering was alone in observing that the current of the voltaic pile might be projected to great distances with as great effective force to produce chemical decompositions as at moderate distances.

Œrsted was alone in originality and time in observing the deflection of the needle by the galvanic current.

Schweigger was coincident with Poggendorff in originality and time in the multiplier of insulated wire.

Arago was alone in magnetizing iron in the axis of a long oblique spiral.

Sturgeon was alone in the electro-magnet with the loose oblique spiral; and later in amalgamating the zinc element of the battery.

Moll and Henry were coincident in the quantity magnet with a single pair.

Henry was alone in the insulated concentric coil and multiplied windings applied to a horseshoe-shaped bar of iron with a single pair and with many pairs. Henry was alone in the insulated concentric wire of many windings and battery of many pairs at a distance from the electro-magnet.

Now all these discoveries, in so far as the attribute of originality is concerned, were in some degree suggested, somewhat in their order of succession, by the publication of the discoveries which preceded them. Œrsted deflected a needle slowly with a single wire, Schweigger and Poggendorff quickly with the multiplied coils.

Arago made straight hard-iron (steel) magnetic by a single loose long coil. Sturgeon made a horse shoe of soft iron magnetic with a loose long coil of sixteen turns and lifted nine pounds in 1825–6. Moll made a closer coil of eighty-three turns and lifted seventy-five pounds, and finally one hundred and thirty-five pounds, in 1828. Henry, with greatly multiplied coils, lifted more than a ton in 1830. All these operated by a battery of a single pair of plates and little interval between the battery and the magnet.

Now Henry started out, before the publication of Moll, with a new combination of *many* pairs, and *distance* between the battery and the magnet, and found as the experiment seemed to show, that the effect of the current in magnetizing soft iron at this distance was at least not appreciably less at a distance of one thousand and sixty feet than at points near the battery.

The lifting of great weights by the single pair of large plates near the magnet, by Sturgeon, Moll, and Henry, was of comparatively little moment to the future telegraph. It was the necessity of producing a *certain* but not great lifting effect at a *distance* that the telegraph required.

Let us make the discovery of Professor Henry clear. He found that a battery of a single pair, the zinc plate four by seven inches, at a distance of eight feet, operating through a coil of insulated wire eight feet long, wound around a small horseshoe magnet, produced magnetism enough to lift four and a half pounds. At a distance of one thousand and sixty feet it lifted but half an ounce, only $\frac{1}{144}$ as much. By now substituting a Cruikshanks' battery, in which was exactly the same amount of zinc surface,—but in twenty-five plates instead of one,—the magnet, at a distance of one thousand and sixty feet, as before, lifted eight ounces. That is, by dividing the zinc plate into twenty-five plates, and putting each with its fellow of copper into a separate cell, the power to lift at a distance of one thousand and sixty feet was increased sixteen times.

Of all the brilliant researches of which this was a small part, this is the one of significance in its relations to telegraphy.

It was the recognition of the relation of the intensity battery to electro-magnetic effects at a *distance*. It does not detract from its importance that chemical effects had been produced by an intensity battery at a distance, as by Hare's deflagrator in 1821, any more than Soemmering's voltaic semaphore, in 1811, detracted from the importance of the discovery of electro-magnetism by Œrsted, in 1819, and the needle semaphore of Schilling of a later period.

WHAT THE INVENTOR OF THE ELECTRO-MAGNETIC RECORDING TELEGRAPH MUST HAVE KNOWN.

What was needed to the original conception of the Morse recording telegraph?

1. A knowledge that soft iron, bent in the form of a horseshoe could be magnetized by sending a galvanic current through a coil wound round the iron, and that it would lose its magnetism when the current was suspended.

2. A knowledge that such a magnet had been made to lift and drop masses of iron of considerable weight.

3. A knowledge, or a belief, that the galvanic current could be transmitted through wires of great length.

These were all. Now comes the conception of devices for employing an agent which could produce reciprocal motion to effect registration, and the invention of an alphabet. In order to this invention, it must be seen how up and down — reciprocal — motion could be produced by the opening and closing of the circuit. Into this simple band of vertical tracery of paths in space must be thrown the shuttle of time and a ribbon of paper. It must be seen how a lever pen alternately dropping upon and rising, at defined intervals, from a fillet of paper, moved by independent clock-work, would produce the fabric of the alphabet and writing and printing.

Was there anything required to produce this result which was not known to Morse?

Of the details of scientific research bearing on electro-magnetism, scattered through journals in various languages, Prof. Morse knew comparatively little. He was a liberally educated gentleman, devoted to the art of painting. He had had, as already mentioned, somewhat unusual advantages. He had attended the courses of lectures of Prof. Silliman and Prof. Day, embracing the sciences of galvanism and electricity, when an under-graduate, in 1808–9–10, at Yale College. He had been an assistant to Professor Silliman in his laboratory in 1822 and the years following. He had, at a later period, attended the lectures of Professor James Freeman Dana, before the Athenæum in New York, and witnessed an original and brilliant course of experimental lectures, embracing all that was known in 1827 on electro-magnetism. Professor Renwick, a fellow-member with Professor Morse in several clubs, remembers that, before the visit of the latter to Europe, in 1829, he paid much attention to electricity and magnetism, and that he was studying those subjects "in reference to the plan for a telegraph." He knew generally, when he stepped on board the Sully, in 1832, that a soft iron horseshoe-shaped bar of iron could be rendered magnetic while a current of galvanic electricity was passing through a wire wound round it, and he knew that electricity had been transmitted, apparently instantaneously, through wires of

miles in length, by Franklin and others. In the course of conversation on board that vessel, the topic of employing electricity to communicate intelligence at a distance arose. In the leisure of ship life the idea of a *recording* electric telegraph seized Professor Morse's mind. He knew, for he had witnessed it years before, that by means of a battery and an electro-magnet, reciprocal motion could be produced. He knew that the force which produced it could be transmitted along a wire. He *believed* that the battery current could be made, through an electro-magnet, to produce physical effects at a distance. He saw in his mind's eye the existence of an agent and a medium by which reciprocal motion could be not only produced but *controlled* at a *distance*. The question that addressed itself to him at the outset was naturally this: How can I make use of the simple up-and-down motion of opening and closing a circuit to write an intelligible message at one end of a wire and at the same time print it at the other? If we pause a moment to consider that in our ordinary writing with a pen upon paper we must employ at least a hundred differently shaped and proportioned lines, and produce them by many hundred combinations of nerve and muscular effort; and that in printing we must have not less than about thirty-six letters and figures, we shall appreciate the grandeur of Morse's conception, in which any message whatever could be written at one end of the wire and printed with perfect distinctness at the other, for permanent preservation, at the rate of twenty-five words a minute. Like many a kindred work of genius, it was in nothing more wonderful than in its simplicity. First, he caused a continuous ribbon or strip of paper to move under a pencil by clock-work that could be wound up. The paper moved horizontally. The pencil moved only up and down; when resting on the paper it made a mark,—if for an instant only, a dot; if for a longer time, a line. When lifted from the paper, it left a blank. Here were three elements,—dots, lines, and spaces,—which, interwoven with intervals of time, could either of them be repeated, or they could be combined variously with each other, to produce groups that should stand for letters.

The grandeur of this wonderful alphabet of dots, lines, and spaces, has not been fully appreciated. It has been translated from one sense to another. In the Morse telegraph it may be

used, and is used, by the sight, the touch, the taste,* the hearing, and the sense of feeling.

Bain succeeded in using the current of electricity without an electro-magnet, but he had to borrow Morse's alphabet. Thompson's reflecting galvanometer, used by the Atlantic cable, employs the Morse alphabet. We are no longer surprised when we find that Steinheil, at the head of German telegraphy, advised the abandonment of his own most ingenious and elaborate apparatus, and the adoption of the Morse system and its alphabet. Nor do we wonder at its general adoption throughout the world.

The conception of the written and recorded alphabet and the mode of printing, all concede to Morse on board the Sully. This conception *presupposes* the use of the electrical current, the employment of the alternate activity and repose of the current, and an apparatus for breaking and closing the circuit at determined intervals.

INDEBTEDNESS OF MORSE TO OTHERS.

The indebtedness of Professor Morse, as an inventor, to others may be regarded as of two kinds. There were the results of scientific research and discovery made by men who had gone before him, and with which he was, in general terms, familiar. Then there was the co-operation of assistants whom he took into his confidence and compensated for their services. Of this latter class were the services of Dr. Gale, his colleague and friend, of Mr. Alfred Vail, and Professor Fisher. Of the former there was Volta, who invented the voltaic pile, Œrsted, Ampère and Arago, Sturgeon and Dana. This was down to 1827. He completed the plan of his alphabet, his mode of writing and printing, and committed them to paper, on board the Sully, in 1832, and exhibited a working model of his conception in action in 1835; and a model, but not in action, of

* The taste is occasionally taken advantage of where accidents occur on the line of railroads and telegraphs, where a skilful operator happens to be present. He cuts the wire, establishes metallic communication with the earth, and signals by uniting and separating the end of the severed wire nearest the station, with the metallic conductor leading to the earth. He receives the message in answer by placing his tongue between the two metallic points, receiving the shocks and observing the intervals between them, which correspond with those produced by the key at the station.

the relay to various persons in 1835 and 1836. His alphabet, his new mode of writing and printing, were clear-cut, realized conceptions; but to perfect the apparatus involved resources, which he had not. There were no shops at that time to which he might go for the ready purchase of electro-magnets, batteries, insulated wires, etc. A blacksmith must be employed to bend an iron rod to the form of a horseshoe, and the wire must be wound by hand. Nor were there at hand facilities for repairs, or professors accomplished and ready to advise in the science scarcely yet developed enough to meet the wants of the inventor. There was not a constant battery. There was, indeed, the battery of many pairs, and Sturgeon had produced his electro-magnet in 1825. But the new art required an inventor.

The substitution by Henry of the concentric multiplier of Schweigger, in place of the loose, oblique coil of Sturgeon, reduced the strength of the battery necessarily required; and the employment of a battery of many pairs in place of a single pair having the same surface, which projected the current through greater length of wire, and so made possible the magnetizing of iron at a distance, revealed the direction in which development was to take place. This disclosed a principle on which the registering apparatus could be worked at a distance. But still there was needed an inventor.

Not one of all the brilliant scientific men who have attached their names to the history of electro-magnetism could bring the means to purchase the practical registering telegraph. Some of them had ascended the tower that looked out on the field of conquest. Some of them brought keener vision than others. Some of them stood higher than others. But the genius of invention had not recognized them. There was needed an inventor. Now, what sort of a want is this?

There was required a rare combination of qualities and conditions. There must be ingenuity in the adaptation of available means to desired ends; there must be the genius to see through non-essentials to the fundamental principle on which success depends; there must be a kind of skill in manipulation; great patience and pertinacity; a certain measure of culture; and the inventor of a recording telegraph must be capable of being

inspired by the grandeur of the thought of writing, figuratively speaking, with a pen a thousand miles long, — with the thought of a postal system without the element of time. Moreover the person who is to be the inventor must be free from the exactions of well-compensated, every-day absorbing duties — perhaps he must have had the final baptism of poverty.

Now the inventor of the registering telegraph did not rise from the perusal of any brilliant paper; he happened to be at leisure on ship-board, ready to contribute and share in the after-dinner conversation of a ship's cabin, when the occasion arose.

Morse's electro-magnetic telegraph was mainly an invention employing power and agencies, through mechanical devices, to produce a given end. It involved the combination of the results of the labors of others with a succession of special contrivances and some discoveries of the inventor himself. There was an ideal whole almost at the outset, but involving great thought and labor and patience and invention to produce an art harmonious in its organization and action.

There was involved what he did not find, as he had assumed. The distance through which any effective force had been called into play, for the work of registration was as an established fact altogether inconsiderable. It was, as a primary fact, to be ascertained in order to the development of the electro-magnetic recording telegraph, whether the distance between the battery and electro-magnet could be increased beyond the narrow limit of previous laboratory experiment to a distance that in use would be *practical*, and, in the event of finding the force becoming feeble with increased distance, to discover a mode of *reinforcing* the current at the point where it became too feeble to produce printing or registration, and so renewing it by the action of the writer at the primary point of transmission, thus making the distance sufficiently great for practical needs.

This was a discovery of the same character as the discovery of the use of the intensity battery. It involved a self-acting device for opening and closing a circuit. It required that the armature in the first circuit should play through a narrow and adjustable interval, near, but not touching the face of the magnet, and far enough to close the second circuit, without getting beyond the reach of the action of the magnet. The armature must also have

an adjustable spring to meet the exigencies of imperfect insulation or enfeebled action of the battery. This discovery of a mode *how* to reinforce the current was the *fruit* of Morse's *thought and experiment*. It was the *relay* which, with its modifications for registering local and side-circuits, was the crowning feature of the recording telegraph.

The discovery that the voltaic current could be made effective in magnetizing soft iron, and produce mechanical effects at a distance of ten hundred and sixty feet was made by Professor Henry.

Morse found that the force diminished with increased distance,— a point doubtful as the result of Professor Henry's experiments,— and he discovered that by addition of successive pairs he could gain sufficient force to produce the necessary mechanical effects at ten miles in 1837, and at a distance of thirty-three miles in 1842. In 1843 he carried the distance up to one hundred and sixty miles, and the results of his experiments were embodied in a paper by Dr. John W. Draper, in the September number of Silliman's Journal of that year.

There has arisen a notion that in the distribution of honors Professor Morse has received credit for some discoveries that was properly due to others. The almost universal adoption of the Morse system, as a consequence of its wonderful simplicity, rapidity of action, and perfectness, has led the great public to feel less interest in the tributary details of what others have done, than in the brilliant result with which the name of Morse is forever combined. The great public is liable to overlook the individual discoveries, which, brought to light from time to time, ministered to the wants of civilization but little by themselves, to the work of him who combined the discoveries of others with his own and his inventions to make them all *useful*.

That strict justice will be done, though it wait long, we must believe. None have suffered more in the absence of its awards, in times gone by, than Professor Morse. Now there is fear that others will get less than is their due.

In Europe, the friends of Professor Wheatstone feel aggrieved. But they need not. The inventions with which his name is connected are quite independent, very brilliant, and useful. In simplicity they are inferior to Morse's. In type they are semaphores, not telegraphs. They are the results of study in the direction of

Ampère and Schilling — needle instruments. The latter in the direction of Steinheil, are magneto-electric instruments. The counting-house magneto-electric apparatus, working with an alphabet and wand, has advantages not exceeded by any apparatus yet devised. Anybody can use it with but little practice.

In our own country there has arisen a conviction that to Professor Henry there has been awarded a less credit, both in the old world and at home, than is justly his due.

This has come partly from the circumstance that of his vast number of researches but few have seen the light. They await a leisure, which the absorbing nature of his every-day duties is continually putting farther away. It is in part due to accident, which is greatly to be deplored, however it may admit of explanation.

It was the serious conviction of Professor Morse, in the later years of his life, that he was not indebted to Professor Henry either directly through personal interview or by correspondence, or indirectly through others, for any scientific discovery in his invention of the recording telegraph. That he was unconscious of any such indebtedness there cannot be a doubt. That he really was, nevertheless, indebted to him indirectly through others, I think, appears from a careful examination of the facts.

It is clear that Professor Henry was the *first* to apply Schweigger's insulated multiplier to the electro-magnet — 1828–29. It is clear that Professor Henry was the *first* to render such a magnet effective through a battery of many pairs *at a distance*. The recording telegraph of Professor Morse rests on principles which these determinations were the first to illustrate. These experiments were first published in January, 1831. The invention on board the Sully was in October, 1832.

The dates of these events are such as to place the labors of Professor Henry in the position of priority in point of time.

The invention of Professor Morse, in 1832, proceeded on the assumption that the velocity of the electric current was infinitely great, and that the voltaic current could be made to magnetize soft iron at great but undefined distances. He was chiefly occupied, at the outset, with the invention of the alphabet, and the means for writing and printing. The chief expenditure of power in writ-

ing was the intelligent human hand. The chief expenditure of power in printing was to be in a falling weight, connected with clock-work, and this weight could be wound up. He had assumed, what was really true, as the event proved, that the electro-magnet could be made to do the rest, according to his conception. With the production and arrangement of the devices connected with the writing and printing, he was occupied at intervals between 1832 and 1835, in which latter year he had completed a working apparatus on a scale adapted to his slender means. He had now, in substance, the whole operating telegraph, with the exception of a proper length of wire for testing the question whether the force could be projected sufficiently far to make the invention *practical;* that is, inexpensive enough to be successfully introduced to public use. He was working with a single pair, — his Cruikshanks battery being out of repair. At this time, early in 1836, Dr. Gale was confidentially invited to see the invention. It was, it should be remembered, in actual working condition, — as an invention containing all that was essential to its demonstrative operation. From this period to the early spring of 1837, circumstances prevented Professor Morse from going on with his invention.

With the recollection of the apparatus working with a single pair, through a comparatively short circuit and a Sturgeon magnet, in the year previous, it was natural that Dr. Gale, on again seeing the apparatus, in 1837, should desire to see it operated with a more powerful battery, a wire of greater length, and a magnet of numerous coils. Professor Morse had (Dr. Gale says in his deposition) "always expressed his confidence of success in propagating magnetic power through any distance of electric conductors which circumstances might render desirable." Dr. Gale would like to see the question tested, and proffered the necessary cups and wire from his own laboratory for the experiment. The result was precisely what Professor Morse had anticipated, — had scarcely doubted.

Dr. Gale, in giving an account of this experiment in a letter to Professor Henry, dated April 7, 1856, and published in the Report of a committee of the Regents of the Smithsonian Institution for 1857, says: —

. . . "The sparseness of the wires in the magnet coils, and the use of the single cup battery were to me, on the first look of

the instrument, obvious marks of defect, and I accordingly suggested to the professor, *without giving my reasons for so doing*, that a battery of many pairs should be substituted for that of a single pair, and that the coil on each arm of the magnet should be increased to many hundred turns each;" . . . "although *I gave no reasons at the time for the suggestion* I had proposed, in modifying the arrangement of the machine, *I did so afterwards, and referred, in my explanations, to the paper of Professor Henry.*" *

It is obvious that Dr. Gale was enabled to make the suggestions he did, and give the co-operation he did, in regard to greater length of wire, and multiplied pairs, and multiplied insulated coils, largely through his acquaintance with the researches of Professor Henry.

Now, in this connection it should be remembered that the *fact* of *numerous coils* around the electro-magnet, made by Pixii as early as 1831, had been mentioned by Dr. Jackson in the first conversation at the dinner-table on the Sully, and Professor Morse recalls it, in his letter to Dr. Jackson of November, 1837, *two years before* any communication had been held with Professor Henry; and in the same conversation, the transmission of a current (the identity of the two — the electric and the galvanic — seems to have been assumed, possibly in view of Faraday's discovery of the drawing of a spark from a magnet), without appreciable loss of energy, four hundred times around the lecture-room of the Sorbonne,— say from twenty to thirty miles, — was mentioned by Dr. Jackson, in the same conversation, and this, too, Professor Morse recalls in the same letter.

In a recent letter from Dr. Gale to the speaker, he says: "But Morse, not having been accustomed to investigate scientific facts, could not appreciate the investigations of Henry as applicable to the telegraph, and I presume that Morse never did fully appreciate the benefit which his machine derived from Henry's discovery."

THE RELAY.

There has been much discussion upon the question of who was the inventor of the *relay*. It has been claimed for Schilling, for Cooke, for Wheatstone, for Henry and for Davy, by those who have

* See Appendix A.

not carefully considered the question, or who are reluctant to acknowledge the claim of Professor Morse. The significance of this feature in the Morse system will justify a full consideration of the subject.

Much of the obscurity rests upon an imperfect appreciation of what the relay is; some of it upon the dates of patents for special applications of the principle; a smaller fraction still on the difference of dates at which the invention was exhibited to the public or brought into actual service; not a little of it on national pride.

To those who conceive that it consists in the production of a special mechanical effect, the effect being the opening of one circuit by the closing of another, will find the invention in the experiment of Professor Henry at Princeton, where he early, and I think first of any, employed an electro-magnet to break the circuit of a quantity battery which through its electro-magnet was holding a great weight.*

But this is not *the relay*. Even if there had existed a device for restoring the circuit and again lifting the armature and its weight it would not have been a *relay*, for it would have brought into play only a *quantity* battery, which as a *relay* for reinforcing the current was worthless. But there was no such device and no length of wire beyond the connection through which as a *relay* the battery could have acted. The physical experiment, as such, had a somewhat nearer relation to a local circuit for registration.

Professor Henry, in his letter to the Board of Regents, of the Smithsonian, March 16, 1857, Ann. Rep. 1857, p. 87, with the magnanimity which belongs to his nature, disclaims this construction of his scientific researches. He says: "My testimony tended to establish the fact that, though not entitled to the exclusive use of the electro-magnet for telegraphic purposes, he was entitled to his particular machine, REGISTER, alphabet, etc." The registering device is the identical device of the relay, except that it is applied to a different purpose. Of the necessity of the *relay* as a means

* Professor Henry opened the circuit of a large quantity magnet at Princeton, when loaded with several hundred pounds, by attracting upwards a small movable wire, by means of a small intensity magnet, connected with a long wire circuit and an intensity battery.

to be ascertained to make transmissions through great distances possible, Prof. Henry had spoken in his letter of May 6, 1839 (see Appendix A). He had evidently up to that time not heard of it.

The *relay* is a *discovery* as well as a device or a series of devices or inventions. It had its birth in the effort to answer the question,—How can the current, which has become feeble through distance from the battery, be *reinforced?* There was need of some principle akin to that which supplies a locomotive and train with fuel, water, and oil, without stopping. The stopping consumes time. To be obliged to repeat the message every few miles would be to abandon it. It would be expensive as well as time-consuming. Now the reinforcement of the current at a distance from the prime station through the very instrumentality of the message sent is an absolute new departure. It is a grand *idea*, primarily, and secondarily it involves inventions of mechanical devices to effect several things. In the first place, there is wanted an electro-magnet at the second station, operated through the battery at the primary station. This magnet must draw its armature not to the face of the magnet, but only very near it, and in so doing close the second circuit. This takes place with the closing of the first circuit. In opening the first circuit, the second circuit is opened at the same instant, and the magnet at the second station with the arrest of the current loses its magnetism. Now a self-acting, adjustable spring draws the armature away from the face of the magnet, through a space very narrow, but adequate to break the circuit at the second station.

Here are the fewest elements of the *relay*. It involves the opening and *closing* of the circuit, by an act going out from the primary station. Of these in Professor Henry's experiment there was the opening *only*. The *relay* opens and *closes* in connection with a conductor of an intensity battery, operating through a long conductor upon a distant magnet. Neither of these was in the experiment at Princeton.

Dr. Gale testifies in the suit of O'Reilly et al. *vs.* Morse et al., among other things, as follows: "That in the month of January, in the year one thousand eight hundred and thirty-six, I was a colleague professor in the University of the City of New York, with Prof. Samuel F. B. Morse, who had rooms in the University

building on Washington square, in said city. That during the said month of January, of the year aforesaid, the said Professor Morse invited me into his private room in the said University, where I saw for the first time certain apparatus constituting his electro-magnetic telegraph."

Here follows a description of the apparatus, and, in reply to cross-questioning, he says that the apparatus was in *perfect* and *working* order when he saw it (in 1836). (Letters from Commodore Shubrick, President Tappan, Robert Rankin, and others, are printed by Professor Morse, fixing the date of the exhibition to them as early as 1835. The testimony of Huntington and Olmstead, pupils in art to Professor Morse in 1835 and 1836, and not thereafter, upon the whole apparatus, including the combined series (relay), is conclusive upon the same point.)

Dr. Gale says, in his deposition: "It was early a question between Professor Morse and myself, Where was the limit of the magnetic power to move a lever? I expressed a doubt whether a lever could be moved by this power at a distance of twenty miles; and my settled conviction was, that it could not be done with sufficient force to mark paper at one hundred miles' distance. To this Professor Morse was accustomed to reply, 'If I can succeed in working a magnet ten miles, I can go round the globe.' The chief anxiety at this stage of the invention was to ascertain the utmost limit of distance at which he (Morse) could work or move a lever by magnetic power. He often said to me, 'It matters not how delicate the movement may be; if I can obtain it at all, it is all I want.' Professor Morse often referred to the number of stations which might be required, and which, he observed, would add to the complications and expense. The said Morse always expressed his confidence of success in propagating magnetic power through any distance of electric conductors which circumstances might render desirable. His plan was thus often explained to me: 'Suppose,' said Professor Morse, 'that in experimenting on twenty miles of wire, we should find that the power of magnetism is so feeble that it will but move a lever, with certainty a hair's breadth; that would be insufficient, it may be, to write or print; yet it would be sufficient to close and break another or a second circuit twenty miles further, and this second circuit

could be made, in the same manner, to break and close a third circuit twenty miles further; and so on around the globe.'

"This general statement of the means to be resorted to now embraced in what is called the 'receiving magnet,' to render practical writing or printing by telegraph, through long distances, was shown to me more in detail early in the spring of the year 1837 (one thousand eight hundred and thirty-seven)." It is to be observed, therefore, that he — Dr. Gale — had not *tested* it, or seen it *tested* before, and all this is in keeping with the letter of Professor Henry to Professor Morse, of date May 6, 1839. He was replying to the inquiry, 'Have you met with any fact, in your experiments thus far, that would lead you to think that my mode of telegraphic communication will prove impracticable?' and writes, — 'I can say, however, that so far as I am acquainted with the minutiæ of your plan, I see no practical difficulty in the way of its application for *comparatively short distances;* but if the length of the wire between the stations be *great*, I think that some other *modification* will be found *necessary* in order to develop a sufficient power at the farther end of the line.'"

At this stage, 1839, two years after the caveat and one year after the application for a patent covering the relay had been passed upon, it is obvious that Professor Henry was not aware of this feature of Professor Morse's plan, — the *relay.* He could not have suggested it; nor could it have already occurred to him. The finding out of the *required modification* was a *discovery*, and certainly one of the most brilliant of all in electro-magnetism applied to electric telegraphy that have at any time been made.

Davy's apparatus, Cooke's and Wheatstone's so-called relays, were not relays at all. They were devices for alarms, — for calls. Devices for this object are as old as Soemmering, in 1811. Henry's bell-ringer at Albany, before 1832 (Professor Hall's letter), was of this class. But let us look at the dates. Cooke was a student at Heidelberg in 1836, when he was invited by an acquaintance to visit (March 6) Professor Moncke's rooms, where he had in operation a rude Schilling telegraph. This device he reproduced partly in Heidelberg and partly in Frankfort on the Maine, and hastened to England, where he spoke of it as "Moncke's telegraph," or the "Heidelberg telegraph." He greatly modified it, and planned

an alarm in the year 1836, which was to *release a detent and set in motion clock-work to ring a bell.* It is easy to see that this had no connection with the idea of a *relay*, a device for *renewing* the *strength* of an expiring current. The device of Cooke was simply a contrivance to wake up an office clerk, or call him to duty. The devices of the Morse relay contemplated the indefinite *extension of the length of wire* through which messages could be sent. It contemplated dispensing with the necessity of calling clerks at intermediate stations to duty, and even of dispensing in great proportion with the services of many officers altogether. Huntington and Olmstead testify to having seen it in 1835.

I should not have dwelt upon this subject at such length had I not seen, in a recent American text-book on chemical forces, that the author, somewhat doubtfully it is true, ascribes the relay to a source which never claimed it, but has distinctly disclaimed it. It is a mistake to refer the relay, conception and execution, to any other source than Professor Morse. The credit to Morse is given without hesitation on the continent of Europe,—among the rest by De la Rive and Steinheil, than whom there are no higher authorities.

THE USE OF WIRE ON POSTS, OR AIR-LINE CONDUCTORS.

The use of wire sustained on posts for conducting frictional electricity through the air goes back at least to Franklin's experiment across the Schuylkill. Watson, in 1747, laid his wire on the ground. For the voltaic current, it was plainly first used by Soemmering, in 1809. It had first, seven hundred and twenty-four feet; two days later, one thousand feet; and ten days later, two thousand feet. Such lengths he did not need to bury for the experiments he made. He eventually used ten thousand feet, and settled conclusively points long after re-discovered, such as the projection of the effective current from an intensity battery to great distances. Air-line conductors must have been next used by Baron Schilling in his experiments, through many miles on his estate, between 1820 and 1832. It was used, according to Gould's statement, by Gauss and Weber, in 1833–34, and by Steinheil in 1837. The use of posts was covered by Morse (unconscious of what had been done before him) in his caveat of 1837.

Some of the friends of Professor Henry have the impression that he made the first suggestion to Professor Morse about the elevation of the conducting wire on posts in the air. This is a mistake. The literature of the case shows that the letters which passed between the two gentlemen do not contain the suggestion. Their first personal interview was in 1839. In Morse's letter to the Secretary of the Treasury, dated September 27, 1837, he says, speaking of the cost of the construction of a working telegraph: "Iron tubes inclosing the wires, and filled in with pitch and resin, would probably be the most eligible mode of securing the conductors from injury, while at the same time it would be the most costly. . . . Iron tubes of one and one-half inches in diameter, I learn, can be obtained at Baltimore at twenty-eight cents per foot. The trenching will not be more than three cents for two feet, or about seventy-five dollars a mile. . . . If the current is laid through the air, the first cost will doubtless be much lessened. . . . Stout spars of some thirty feet in height, well planted in the ground, and placed about three hundred and fifty feet apart, would in this case be required, along the tops of which the circuit might be stretched." It will thus be seen that the plan was original with Professor Morse, although, to him unknown, Steinheil used the posts and elevated wire in the same year, and in the next year published an account of it.

USING THE EARTH AS PART OF THE CIRCUIT.

In the experiments of Watson and Franklin with frictional electricity, the earth was used, as we have seen, as a part of the circuit.

Steinheil was the first to use it as part of the circuit of the voltaic current in 1837; Morse adopted it in 1845.

THE STOPPING APPARATUS.

This ingenious device for starting the fillet of paper at the instant the message begins to be received, independently of the attention or presence of the office clerk, and stopping it, as soon as the message has been received, so as to prevent waste, was invented by Professor Morse, in 1837, and fully described by Alfred Vail in his

work on Telegraphy, in 1845. The instrument was patented in France in 1838, and in this country in 1846. It was improved upon by Sortais in 1861 or 1862, and invented anew by Professor Wheatstone in 1863. The invention of the latter is spoken of in a contemporary public print, as follows: "A merchant can now lock up his counting-house, and on his return find every message faithfully recorded in legible type, during his absence, by this beautiful little machine."

The report of the Committee on Commerce of the House of Representatives, December 30, 1842, announced as follows, in giving the superior advantages of Professor Morse's invention: "Possessing an advantage over electric telegraphs heretofore in use, inasmuch as it records, in permanently legible characters on paper, any communication which may be made by it, *without the aid of any agent at the place of recording, except the apparatus*, which is *put in motion at the point of communication.* Thus the recording apparatus, called the register, *may be left in a closed chamber, where it will give notice of its commencing to write by a bell, and the communication may be found on opening the apartment.*"

In the course of the protracted litigations to which Professor Morse has been subjected in defence of his rights, every source of testimony has been exhausted to shake, if possible, his claims to originality and priority. Scientific experts and rival claimants have been marshalled, on repeated occasions, to sustain the assault by every means in their power. The effort could not well have been stronger. It has on every occasion been overwhelmingly defeated.

The decisions of the highest tribunals in the country, — the Supreme Court of the United States and the Patent Office, — which have been rendered in these cases, are so clear, emphatic and convincing, that they must forever be accepted as determining affirmatively all the questions bearing on Professor Morse's claims that can fall to courts weighing human testimony.*

In our sketch of the history of the recording telegraph we were brought down to the period of the successful working of the Morse apparatus between Baltimore and Washington in 1844.

* See Appendix C.

The public journals of that time and of recent date have made us familiar with the details, — the jeers, the buffetings, the struggle, the self-sacrifice which attended the effort to procure the appropriation by Congress of the money necessary to construct the first experimental line. It is not in my province on this occasion to dwell upon them, nor upon the plaudits and honors and fortune that came at last to crown the noble life which has so recently closed.

I will occupy but a moment further in stating, in a word, what I conceive to be the just claims of Professor Morse as the inventor of the electro-magnetic recording telegraph.

WHAT WAS HIS OWN?

1st. The conception of *registration*. This underlaid the idea of an alphabet. It involved the fillet of paper moving by clockwork with uniform velocity under the lever pen, rising and falling at measured intervals, controlled by the transmitting key operating the electro-magnet through the opening and closing of the galvanic circuit. It included the mathematical and mechanical conception of the combinations of dots, lines, and spaces, to stand for letters, whether recorded chemically or by pressure.

2d. The combined series, or *relay*, which made it practical to transmit from any station intelligence to any point, however far, and to receive and record messages at the end, and at all intermediate points, however numerous.

3d. The first practical determination that the galvanic force could be made practically operative through sufficiently great distances without repetition, to render the recording telegraph a practical success, suited to public use.

4th. The electro-magnetic sounder, or acoustic semaphore, with an alphabet corresponding to dots, lines and spaces.

5th. The stopping apparatus, for controlling the movement of the fillet of paper at a distant station through the key of the transmitting office.*

* Professor Morse suggested to Arago, in 1839, the use of the electro-magnetic recording telegraph for determinations of longitude. He seems to have been the first to lay a working submarine cable.

6th. The *combination* of the battery of Volta, improved by Daniell; the electro-magnet of Sturgeon; the multiplied insulated coil, and the battery of many pairs and long-conducting wire of Henry; and the single wire and earth circuit of Steinheil, — with his own writing and registering apparatus, including the key, lever-pen, moving fillet of paper, stopping apparatus, and register-magnet; his own alphabet of dots, lines and spaces, and his own relay working with an intensity battery, — all proportioned and adjusted in a harmonious whole of extreme simplicity, and adapted to practical working for every-day public use.

7th. He is entitled to the further honor of having fought and conquered the difficulties, scientific, pecuniary, material, and in the way of legislation and litigation, which the effort to make the invention *useful* and *successful* encountered. The strength and faith and patience and courage with which he pursued his invention to its completion are the attributes which men honor.

If we do not credit to Professor Morse individual discoveries in electro-magnetism, which he never claimed, we ascribe to him the greater honor of having cast previous discoveries into the alembic of his own mind, and evolved the first practical registering telegraph, and so made those discoveries by fusion with his own discoveries and inventions subservient to the highest interests of civilization.

REMARKS OF MR. DANA.

The Mayor next introduced the Hon. R. H. Dana, Jr., who said:—

Mr. Mayor, — Ladies and Gentlemen: — After such an event as the announcement of these dispatches from all parts of the world, any attempt to impress upon our own minds the value of this invention seems to me to be superfluous. Can we make it real to ourselves that China and Egypt are conversing with Boston and Washington, and expressing their sympathy in the loss and their admiration of the character of this great discoverer? Why, a few years ago, Mr. Mayor, when I went to China and to Japan, they seemed to me to be places very far off. I thought I never should get to Japan, and when I got there I didn't know that I should ever get away. But now the Japanese ambassadors in Washington converse with their government daily, by the wonderful invention of that man whom we are called together to honor to-night.

I should like, Mr. Mayor, to have your permission — I should be proud to be the organ of this assembly— to convey to Professor Horsford our united thanks for the lucid, just and interesting statement he has made of the nature and history of Mr. Morse's invention. I am sure I have the approval of you all when I venture to tender him, in your name, our united thanks and congratulations. [This proposal of Mr. Dana was responded to by hearty applause from the audience.]

It is an honored custom of Boston, Mr. Mayor, that the chief magistrate of our city should call together the citizens whenever any great event has occurred in which we are all interested. Especially has it been our custom to assemble in this hall to mingle our sympathies and express our regrets when the community is deprived by death of the services of an illustrious citizen. There are some I see here upon this platform, who can remember when Faneuil Hall was filled to commemorate the death of the elder Adams. There are more who can remember when Faneuil Hall was again filled to hear the eloquent notes of Everett on the death of the younger Adams, and again of Lafayette; and, sir, yester-

day those flags, drooping from half-mast, mourning the untimely fate of him who had upheld them and the republic of which they were the symbols, in the darkest hours, — remind us, sir, of the days when this hall wore the emblems of mourning for the death of our great chief magistrate, patriot, and martyr. As we are looking about this hall, at these pictures upon its walls, we are reminded that it is mainly to the heroes and patriots and sages and statesmen of the land that the honors of these occasions have been given. But, sir, I am sure you will say — I am sure that all present will agree — that we are met to-night on an occasion worthy of this place, worthy of our best efforts, and appealing to the best feelings of every American. We are met to pay honors to one of the heroes of peace. It is right, eminently right, that the citizens of a republic more than those of any other government, should give a generous recognition to great public merit. Under the old systems in other parts of the world, they have their modes of remunerating public benefactors. There are orders of merit that are conferred upon them. There are titles of nobility and pensions to them and their descendants. To the latest generation, the descendant bears a title which everywhere and to all persons recalls the great citizen upon whom that title was first conferred. Now we, citizens of a democratic republic, have discarded, on principle, all these methods of encouraging effort and rewarding success. We consider them to be unreasonable and unnecessary, and inconsistent with the fair rights and interests of the greatest number. But it has always seemed to me that for that very reason there is a tenfold obligation resting upon the citizens of a republic to give the freest and most generous expression of gratitude and admiration to their fellow-citizens who have been the benefactors of their race. We have no title of nobility to confer upon Morse. We enroll his name in no legion of honor. So much the rather must we give him the admiration of our understandings, and the warmest affections of our hearts.

Mr. Mayor, I can contribute nothing like that which has been contributed by Professor Horsford, of a scientific character, respecting Mr. Morse. What little I can say, of a humbler sort, I respectfully submit to my fellow-citizens. In my boyhood I knew him; in my earliest manhood I knew him. I had the honor I may not truly say of his friendship, but certainly of his most friendly

acquaintance. He was connected with those I most loved and honored in the world, by ties, not of blood, but of affection and common pursuits and common studies; and I know from the earliest period, before he was known to the world as the great inventor, the affection and respect which were entertained for him by all persons who came within the range of his acquaintance. Findley Morse,— by that name I always love to speak of him, for so I always heard him called by his friends, — Findley Morse was a youth of remarkable personal beauty, of very attractive manners, of a most enthusiastic temperament, of a pure heart and a blameless life. There are no drawbacks in the eulogies which we can pronounce upon Mr. Morse. All these characteristics he had; and I am reminded to-night, by seeing upon the platform one of the heroes of the war of 1812 and '14, whose vacant sleeve carries with it always the memory of the gallant sortie of Fort Erie — [This reference to Col. Aspinwell was acknowledged by loud applause] — I am reminded that Mr. Morse with two or three other Boston citizens was, unfortunately, overtaken and detained in London by the unexpected breaking out of that war. I have frequently heard these gentlemen, his companions (among them Washington Allston), speak of this characteristic — the ardent and enthusiastic patriotism of Mr. Morse. It knew no bounds. So intense was it that it sometimes endangered his personal safety. Why, he loved the old frigate Constitution, launched within sight of his father's house, as he loved his brother. When the news came that she had captured the Guerriere, and brought her into Boston, and then again the Java, his enthusiasm rose to fever heat. Throughout the war, his spirits sunk or rose, like a thermometer, with the tidings of good or ill success of his country. Had he been at home, every faculty of his ardent nature would have been given to her service.

It has always seemed to me that Mr. Morse's invention is the most attractive to the imagination of any ever made. Its utility and extent no one can overstate. But other inventions are vastly useful. This partakes of a spiritual character. If not spirit itself, it is born of the spirit. We often hear it said, we sometimes feel, that progress in material arts, and the advance of material sciences, may tend to lower the tone of the soul, and to depress the highest aspirations of the spirit. As to some of them, this may be true;

but do we not feel that in this invention, the mysteries of that border land between sense and spirit are brought home into our daily lives? Does not this invention "feelingly persuade us what we are"? Much of matter, which our senses recognize, but more of spirit, which is beyond our senses. It wakes up our imaginations to the truth that the earth is filled with an invisible, intangible essence, of which we see nothing, and know scarce more than nothing, which yet a few slight and simple applications of matter anywhere, everywhere, can evoke and bring into an intensity and power of action of which our fancies would never have conceived, and which are to us still a never-ending wonder. The most powerful poisons, indeed, the most powerful material agencies of all kinds, are almost in the inverse ratio of their bulk and of their effect upon any of the senses. The invisible are the most powerful of all. Such results of science, then, as Mr. Morse has brought to light, in such fields of research, instead of tending to belittle or depress spirit and subject it to matter, teach us that the forces unperceived by the senses are the real powers in the universe of matter. They preach over again to us not in words, but in act, the sublime lesson of the Scriptures,— things not seen are eternal. But, Mr. Mayor, there are many others whom you have kindly invited to say a word to the citizens of Boston this evening, and I must not trespass further upon these sacred hours. I wish simply to join with my fellow-citizens, for one moment, in the expressions of gratitude which we owe, and which all portions of the world owe to this great inventor. There is not a spot of the habitable earth that might not well respond to-night in tones of sympathy and gratitude. The last despatch you received was dated from Egypt. But, sir, that is not all. I am not over-sanguine, I am sure, when I say that not many years hence there will be the magnetic telegraph across the deserts of Africa. It will wake into life that vast silent continent, and Ethiopia will stretch forth her hands for the grasp of her brethren throughout the world. One touch of the electric wire, like one touch of nature, makes the whole world kin.

But of all the places which may well respond to-night, there is none that has a better claim to be heard, none upon which the duty of speaking with the heart and with the understanding in his

memory presses more urgently than upon Boston and this hall. For, Mr. Mayor, Boston is the capital of the State of his birth; and he was born in one of those valleys that lie between Bunker Hill and Faneuil Hall.

REMARKS OF MR. E. P. WHIPPLE.

The Mayor then presented Mr. Whipple, who spoke as follows: —

Mr. Chairman: I am specially attracted to this meeting, because its purpose is to commemorate the work of an inventive mind. The government of the city of Boston, in calling a meeting in Faneuil Hall to honor the dead inventor of an invention which can never die, has shown itself on a level with the science and the humanity of the age. Our civilization depends for its progress on an ever fresh supply of intellects, which force reluctant Nature to yield up secrets she jealously hoards and hides. Such intellects extend the dominion of the human intelligence, and are, at the same time, the beneficent creators of new wealth, to satisfy human needs. It is computed that Henry Cort, whose machines created the iron manufacture of Great Britain, added £600,000,000 to its national wealth, and that Bessemer's process of making steel has already added £200,000,000. Here is a sum, equal to the whole vast national debt of England, which is to be traced to two inventive brains. Great Britain spent a thousand millions of pounds sterling in her twenty years' contest with revolutionary and imperial France. Who supplied the sinews of that long and terrible war? The answer is, James Watt and Richard Arkwright, two men who gave to their country labor-saving machines which represented the manual labor of five hundred millions of men. English statesmen and generals, with all their blunders, could not waste wealth as fast as Watt and Arkwright created it; and the first Napoleon was at last overwhelmed, not by Pitt, Perceval, Liverpool or Wellington, but by two illustrious inventors, one of whom began life as a mathematical instrument maker, and the other as a penny barber. I doubt if any of us, with all our familiarity with the marvels wrought by mechanical invention, realize the enormous debt of gratitude we owe to such countrymen of ours as Whitney, Fulton, Goodyear, McCor-

mick, Bigelow, Howe and Morse. As to Morse, he earned at one time a precarious living in New Hampshire by painting portraits at fifteen dollars a head. Who could have supposed that from such an artist would have sprung such an artisan?

But as to Morse's particular invention, allow me to recall to your memories the well-known lines of Byron, as he witnessed a thunder-storm among the Alps: —

> "Could I wreak
> My thoughts upon expression, and thus throw
> Soul, heart, mind, passions, feelings — strong or weak,
> All that I would have sought, and all I seek,
> Bear, know, feel, and yet breathe, into *one* word,
> And that one word were Lightning, I would speak."

Well, Morse has not only compelled lightning to speak, but to write. He has forced it not merely to flash terror, but to flash intelligence. He has made it the obedient, humble servant of the meanest as well as the greatest of men and women. Under his control, it condescends even to be doting, garrulous, insipid, a retailer of gossip, a thrall of scandal-mongers. You all recollect the remark of the old lady, when she saw the telegraphic poles set up before her country cottage. "Now," she spitefully said, "I suppose nobody can whip a child without its being known all over creation." Certainly not, my good woman! The press of Calcutta and St. Petersburg will hear every slap, hold you to a strict account, and stigmatize every stroke of superfluous castigation of infantile disobedience. Even the restless Yankee who, asking the operator, in the early days of the telegraph, how long it would take to send a message to Washington, and being informed it would take five minutes, replied, "I can't wait," can now be satisfied. By the blessed difference in time, he can at present be consoled by the assurance that his telegraphs to some places will arrive several hours *before* he sent them! In short, Franklin drew the lightning from the skies; Morse has sent it over the earth to run errands, — an ignominious but still to us a very convenient work for an element in itself so sublime, so smiting and so wrathful!

But the taming of the seemingly untamable lightning has

worked noble as well as frivolous results. It enables great nations to communicate with each other in a minute of time, and to avoid war by the instantaneous flashing of the thoughts of each statesman into the minds of all statesmen. It enables the great merchant, in his summer resort at Newport or Saratoga, to direct the courses of his ships, separated from him by three, or ten, or fifteen thousand miles of mere distance, and equalizes prices by demonstrating the folly of monopoly. It enables the press to annihilate space, and to bring, every morning and evening, Europe, Asia and Africa to your doors. And last, though not least, it makes every throb of the human heart — every dear and tender anxiety for absent friends, parents, lovers — known everywhere, and converts Boston, London, Paris, Berlin, Bombay and Hong Kong into one great metropolitan city.

REMARKS OF HON. GEORGE S. HILLARD.

Mr. Hillard was then introduced. He said: —

It is an honorable fact in the history of our country that at this moment, all over the land, men are met together to do honor to a man whose claims to memory and distinction rest upon the fact that he was eminently successful in applying the laws of science to the arts of life. With peculiar propriety it belongs to us to do honor to Mr. Morse, because he was of us. He was born but a rifle-shot from this spot; he was reared under influences indigenous to our soil. We have a right to a local pride in him. Local pride, national pride, is a proper and commendable sentiment, within reasonable limits. We have a right to be proud of our great men. Every great man is the product of two factors; one is his original capacity, and the other the institutions and conditions under which he was reared. I suppose Mr. Morse would hardly have invented the electric telegraph if he had been born in Mexico or Peru.

I do not propose, fellow-citizens, to travel over the ground which my predecessors have traversed. Who is he that cometh after three such kings? Allow me to deflect a little, seemingly, from the path of thought before us; and yet I mean to be guided

by a law which shall in due season bring me back again. I am reminded here, to-night, of two other men, between whose lives and that of Mr. Morse there is a peculiar parallelism. One of these, Franklin, has already been mentioned, was all our own. He was born here, in Boston, at the beginning of the last century. The other is Count Rumford, born in Woburn, about ten miles off. Franklin was born about forty years before Rumford, and Rumford about forty years before Morse. Their respective birth dates mark the beginning, the middle, and the end of the eighteenth century. These three men were memorable for investigations and inventions in heat, light, electricity, and electro-magnetism,— those airy and imponderable essences which seem more like thought acting through matter than like matter itself. All three were practical men, making their science subserve the use and wants of man in daily life. With the first we associate the lightning rod and the Franklin stove, and with the second, the Rumford oven and the Rumford fireplace. These, you may say, are but simple, trivial things; but in a climate where for eight months in the year our first thought is how to keep warm, the man that economizes fuel on a great scale is a public benefactor. And so is he who lightens to one half of creation the daily burden of cooking. But Franklin and Rumford, besides being practical men, were great scientific discoverers. Franklin discovered the identity of lightning and electricity, and Rumford that heat is but a mode of motion. These are vital and germinating truths. You know how high is the place of Franklin on the rolls of fame, as a man of science; and I have the impression that the reputation of Rumford as a scientific discoverer is rather on the increase at the present time.

In other respects these three eminent men were alike. Each reached a good old age; each had the good fortune, which all inventors and discoverers do not have, of reaping the harvest of success with their own hands. While yet alive, they had honors, recognition, and wealth; they did not die before the sight of the promised land, towards which their hopes and their thoughts were turned. And there is another point in which these men were alike, that is the patience and tenacity with which they grasped an idea, and never let it go till success was achieved; the power

of steadily contemplating a subject, without turning their glance to the right or the left, which Sir Isaac Newton said was the only point wherein, so far as he knew, he excelled other men.

Mr. Morse did not pretend to be an original discoverer in science. He would have disclaimed all such honor, for he was a modest man. His merit, as Prof. Horsford has told you, was, in the first place, the skill and ingenuity with which he devised an instrument more expeditious, simple, and cheap for doing what others, in other parts of the world, were also trying to do; and in the second place, the perseverance with which he persisted in knocking at the door of Congress for aid, never discouraged by repulse, until at last, as iron is made hot by repeated blows, apathy and opposition were alike overcome; and success crowned his labors. Many men, by tongue or pen, drop brilliant hints, striking suggestions, make lucky guesses and happy predictions, but as Paley says, he alone discovers who proves. It is the man who puts an idea into shape, who gives it form and substance, and he alone, who writes his name on the enduring tablets of fame.

Another remarkable thing about Mr. Morse was that he was forty years old before he began to think of being a man of science. Up to the age of forty he was an artist; and in that capacity more than respectable; indeed of high merit. In the sixteenth century there were men who were eminent in art and science both. Michael Angelo was one; Leonardo da Vinci was another. The latter was eminent in science, and it is only his greatness as an artist that has thrown his scientific reputation into the shade. But I don't recall anybody during the last hundred years who was, as Mr. Whipple so felicitously said, first an artist and then an artisan, as Morse was. For forty years he was a creator of beauty. He then left these flowery paths and gave himself to the stern realities of practical life, and what marvellous results he accomplished! It is never too late, my friends, to turn over a new leaf in the great book of knowledge.

Nor should we forget here the man, Morse, when we are met to honor him as an artist and an artisan. Behind the fact of what a man does, there stands the fact of what he is. Mr. Morse will here bear the strictest scrutiny. There have been artists of great genius whose lives their biographers have been willing to throw

into shadow; and there have been men of science with infirmities of temper and weaknesses of character over which charity draws a veil. But Mr. Morse was always a man of high personal character. When an artist, he resisted the peculiar temptations to which artists, from their impressionable temperament, are often apt to yield. He was simple in his habits, a hard worker, and pure in life and conversation. The beauty he worshipped was high and ideal, not sensual or debasing. So when we view him as a man of science, we see the same elements of character; self-respect, self-control, no unseemly self-assertion, no taste for needless controversy, but always a calm, serene, equable spirit. His was a noble life in both respects, that of art and that of science.

Heaven gave him not merely honor and wealth, but also other blessings. It gave him an old age without infirmities, an old age surrounded by all that should accompany old age. His death was the going down of a great light in a calm and serene horizon.

As I have before said, it is an honorable thing for us that we come here to do honor to the memory of this eminent, this pure and good man. It marks a progress in civilization when men assemble to do honor, not merely to the great soldier and the great statesman, — all praise to them in their spheres, — but to the artist, who pours the hues of beauty around the paths of daily life; to the scientific discoverer, who by patient investigation forces coy and reluctant nature to reveal the secrets she is always anxious to hide; to the practical mechanician who applies these laws to the service of humanity, lightening the burden of toil and the pressure of poverty. These men are heroes; they are soldiers in that great battle which has always been going on between ignorance and knowledge, error and truth. Their triumphs are without alloy; their victories are bloodless; in them is not mingled the wail of the widow or the tear of the orphan.

APPENDICES.

APPENDIX A.

The effect of the suggested addition of more cups and coils was no surprise to Professor Morse. It was precisely what he expected, and had assumed, and, one may add, would have exhibited, if he had had the means before the interview with Dr. Gale.

Whatever Dr. Gale may have said to Professor Morse at any time, the latter was obviously unconscious that any suggestions he, Dr. Gale, had made, were other than such as might be made by any one familiar with the principles of electro-magnetism *then known*, acting as his "confidential scientific friend." He lodged his caveat in 1837, applied for his patent April 7, 1838, and sailed for Europe immediately after. He returned in March, 1839, and found Dr. Gale had sailed on the very day of his arrival, for New Orleans. In the following month (April 24, 1839), he wrote Professor Henry as follows: —

"New York, April 24, 1839.

"My dear Sir, — On my return, a few days since, from Europe, I found directed to me, through your politeness, a copy of your valuable 'Contributions,' for which I beg you to accept my warmest thanks. The various cares consequent upon so long an absence from home, and which have demanded my more immediate attention, have prevented me from more than a cursory perusal of its interesting contents; yet I perceive many things of great interest to me in my telegraphic enterprise. I was glad to learn, by a letter received in Paris from Dr. Gale, that a spool of five miles of wire was loaned to you, and I perceive that you have already made some interesting experiments with it. In the absence of Dr. Gale, who has gone South, I feel a great desire to consult some scientific gentleman on points of importance bearing upon my telegraph, which I am about to construct in Russia, being under an engage-

ment with the Russian government agent to return to Europe for that purpose in a few weeks. I should be exceedingly happy to see you, and am tempted to break away from my absorbing engagements here to find you at Princeton. In case I should be able to visit Princeton for a few days, a week or two hence, how shall I find you engaged? I should come as a learner, and could bring no 'contributions' to your stock of experiments of any value, nor any means of furthering your experiments, except, perhaps, the loan of an additional five miles of wire, which it may be desirable for you to have.

"I have many questions to ask, but should be happy, in your reply to this letter, of an answer to this general one: Have you met with any facts, in your experiments thus far, that would lead you to think that my mode of telegraphic communication will prove impracticable? *So far as I have consulted the savans of Paris, they have suggested no insurmountable difficulties.* I have, however, quite as much confidence in your judgment, from your valuable experience, as in that of any one I have met abroad. I think that you have pursued an original course of experiment, and discovered facts of more value to me than you have published abroad.

"I will not trouble you at this time with my questions until I know your engagements. Accompanying this is the copy of a Report made by the Academy of Industry, of Paris, on my telegraph, which I beg you to accept.

"Believe me, my dear sir,
"With the highest respect,
"Your most obedient servant,
"SAMUEL F. B. MORSE.

"To Prof. JOSEPH HENRY, Princeton."

To this letter was received the following reply: —

"PRINCETON, May 6, 1839.

"DEAR SIR, — Your favor of the 24th ult. came to Princeton during my absence, which will account for the long delay of my answer. I am pleased to learn that you fully sanction the loan which I obtained from Dr. Gale, of your wire, and I shall be happy if any of the results are found to have a practical bearing on the electrical telegraph.

"It will give me great pleasure to see you in Princeton after this week; my engagements will not then interfere with our communications on the subject of electricity. During this week I shall be almost constantly engaged with a friend in some scientific labors which we are prosecuting together.

"I am acquainted with no fact which would lead me to suppose that the project of the electro-magnetic telegraph is impracticable; on the contrary, I believe that science is now ripe for the application, and that there are no difficulties in the way, but such as ingenuity and enterprise may obviate. But what form of the apparatus, or what application of the power will prove best, can, I believe, be only determined by careful experiment. I can say, however, that so far as I am acquainted with the minutiæ of your plan, *I see no practical difficulty in the way of its application for comparatively short distances;* but *if the length of the wire between the stations be great, I think that some other modification will be found necessary, in order to develop a sufficient power at the farther end of the line.* I shall, however, be happy to converse freely with you on these points when we meet. In the mean time, I remain,

"With much respect, yours, etc.,

"JOSEPH HENRY.

"To Professor MORSE."

Now at this period the telegraph had been exhibited in practical operation, first, with a short circuit to numerous friends and pupils, in 1835, then, with a circuit of ten miles, to the public in New York, in 1837; to a committee of the Franklin Institute, in January of 1838, and for three months following to the Cabinet and Congress at Washington; to the Academy of Science and thousands of visitors in Paris in the autumn of this year. All this happened *before* he had read Professor Henry's paper. As his apparatus employed ten miles of wire, and Professor Henry's paper spoke of the use of but ten hundred and sixty feet, it is not singular that he should have felt that he did not owe the discovery that the effective current could be sent through great distances to Professor Henry.

"A few days after the receipt of this letter," says Professor Morse in his account, "I visited him, having prepared beforehand

a few questions, the better to economize his time. The following is the copy of the original paper (which I preserved) with the answers of Prof. Henry, so far as they were given, put down by me in pencil at the time:—

Questions prepared to ask Professor Henry and shown him in my visit, May, 1839, and his answers on reading them to him:—

1st. Have you any reason to think that magnetism cannot be induced in soft iron, at the distance of one hundred miles or more, by a single impulse, or from a single battery apparatus?—"No."

2d. Suppose that a horseshoe magnet of soft iron, of a given size, receive its maximum of magnetism by a given number of coils around it, of wire or of ribbon, and by a given-sized battery, or number of batteries, at a given distance from the battery, does a succession of magnets introduced into the circuit diminish the magnetism in each?—"No."

3d. Have you ascertained the law which regulates the proportion of quantity and intensity from the voltaic battery necessary to overcome the resistance of the wire in long distances, in inducing magnetism in soft iron?—"Ohm has determined it."'

The only remaining letter to Professor Morse affords evidence of the kindly interest of Professor Henry in the invention of Professor Morse, and is here inserted.

"PRINCETON COLLEGE, Feb. 24th, 1842.

"MY DEAR SIR,—I am pleased to hear you have again petitioned Congress in reference to your telegraph, and I most sincerely hope you will succeed in convincing our representatives of the importance of the invention. In this you may, perhaps, find some difficulty, since, in the minds of many, the electro-magnetic telegraph is associated with the various chimerical projects constantly presented to the public, and particularly with the schemes so popular a year or two ago for the application of electricity as a moving power in the arts. I have asserted, from the first, that all attempts of this kind are premature, and made without a proper knowledge of scientific principles. The case is, however, entirely different in regard to the electro-magnetic telegraph. *Science is now fully ripe*

for this application, and I have not the least doubt, if proper means be afforded, of the perfect success of the invention.

"The idea of transmitting intelligence to a distance by means of electric action has been suggested by various persons, from the time of Franklin to the present; but until within the last few years, or since the principal discoveries in electro-magnetism, all attempts to reduce it to practice were necessarily unsuccessful. The mere suggestion, however, of a scheme of this kind, is a matter for which little credit can be claimed, since it is one which would naturally arise in the mind of almost any person familiar with the phenomena of electricity; but the bringing it forward at the proper moment when the developments of science are able to furnish the means of certain success, and the devising a plan for carrying it into practical operation, are the grounds of a just claim to scientific reputation as well as to public patronage.

"About the same time with yourself, Professor Wheatstone, of London, and Dr. Steinheil, of Germany, proposed plans of the electro-magnetic telegraph; but these differ as much from yours as the nature of the common principle would well permit; and unless some essential improvements have lately been made in these European plans, I should prefer the one invented by yourself.

"With my best wishes for your success, I remain, with much esteem,

Yours truly,

"(Signed) Joseph Henry.

"Professor Morse."

APPENDIX B.

The Abbe Moigno published in 1837 a letter from Dr. Jackson, in which the latter lays claim to the whole invention of Morse's telegraph. The claim is repeated in the "Boston Post," in 1839.* This claim is supported in some degree by a statement of Dr. Hamel, of St. Petersburg, who visited this country during the Crimean war, and saw the note-book of Dr. Jackson. It is intimated in the work of Kuhn (Leipsic, 1866) that the claim of Morse to the period of 1832 as the date of the invention of the Morse telegraph shows a want of love of truth.

In view of these imputatians upon the good name of a man, all of whose writings and private and public life point him out as high-toned and sensitively just and truth-loving, and in view of my instructions to present a sketch of Professor Morse's connection with the electric telegraph, I have no alternative but to proceed to the vindication of Professor Morse.

The public notice of Cooke and Wheatstone's telegraph, in 1837, had awakened Professor Morse's solicitude lest the honor of the first invention of a practical working telegraph should be lost to

*In an article in the "Boston Post," of January, 1839, the data of which were furnished by Dr. Jackson, occurs the following: "We are informed that the invention of the electro-magnetic telegraph, which has been claimed by Mr. S. F. B. Morse, of New York, is entirely due to our fellow-citizen, Dr. Charles T. Jackson, who first conceived the idea of such an instrument during his return voyage from Europe in the packet ship *Sully*, in October, 1832.

"*The origin of the idea of the telegraph, as above stated, can be proved by a number of passengers on board the Sully;* and Mr. Rives, the American ambassador to France, Mr. Fisher, of Philadelphia, and Captain Pell, of the *Sully*, having listened to the conversation, will recollect that Mr. Morse acknowledged himself wholly unacquainted with electro magnetism, and that Dr. J. freely informed him of every particular discovery applicable to the case."

In a deposition made in 1848, Dr. Jackson appeals to the same gentlemen, — "During the conversation with Mr. Rives and Mr. Fisher, were present two Messrs. Palmer of New York, and Captain William Pell."

our country. Conscious that his invention had been made on board the *Sully*, in 1832, he addressed a circular letter to several of his fellow-passengers, expecting with their replies to be able to confirm his claim to priority. The letter was as follows: —

"New York City University, August 27, 1837.

"Dear Sir: — You may have seen some notice in the papers of an electric telegraph, of which I am the inventor. There is to be a contest, it seems, for priority of invention of this electric telegraph between England and France, Germany and this country. I claim for myself, and consequently for America, priority over all other countries in the invention of a mode of communicating intelligence by electricity. My object in writing you is to ask whether you remember my conversing on the subject of the electric telegraph, as my invention, when a fellow-passenger with you on board the ship *Sully*, Capt. Pell, in the month of October, 1832. If you do, please inform me as soon as possible, and state precisely what you remember concerning it. Your testimony to the fact of my having invented it at the time will be important in establishing the priority of the American invention.

"With sincere respect, sir, your obedient servant,

"S. F. B. MORSE."

To the letter to Dr. Jackson he added the following sentence: "My plan of marking by means of an electro-magnet has proved completely successful."

To the letter to Captain Pell he added this sentence: "Have you ever spoken of my invention to passengers in subsequent passages?"

To the letter to Mr. Palmer, this sentence: "If those of your family who remember anything of the matter would testify to the same it would be doing me an essential service."

In answer, he received from Mr. Fisher the following under date of September 19th, 1837, and said: —

"I certainly recollect many conversations with you on the subject of an electric telegraph, during our voyage from Europe, in the *Sully*, in October, 1832. . . . .

"I am at any time ready to give my certificate that you proposed

and were occupied about the details of an electric telegraph at the time referred to. Wishing you all success in this as well as every other occupation, and that the establishment of your fame for this invention may be as extensive as it is deserved,

"I remain," etc.

Captain Pell answered on the 27th September, 1838, and among other things said: —

"I am happy to say I have a distinct remembrance of your suggesting, as thought newly occurred to you, the possibility of a telegraphic communication being effected by electric wires. As the passage progressed, and your idea developed itself, it became frequently a subject of conversation. Difficulty after difficulty was suggested as obstacles to its operation, which your ingenuity still labored to remove, until your invention, passing from its first crude state through different grades of perfectionment, was, in seeming, matured to an available instrument, wanting only patronage to perfect it and call it into reality. And I sincerely trust that circumstances may not deprive you of the reward due to the invention, which, whatever be its source in Europe, is with you at least I am convinced, original."

Mr. Rives answered on the 21st of September, 1837, and said: —

"I retain a distinct recollection of your having explained to me the conception of this ingenious invention during our voyage from France to the United States, in the autumn of 1832, and that it was more than once the subject of conversation between us, in which I suggested difficulties that you met and solved with great promptitude and confidence."

Mr. Charles C. Palmer had left the country, we believe, and did not answer.

It is evident, from the depositions and letters of Mr. J. F. Fisher, of Philadelphia, Hon. William C. Rives, of Virginia, ex-minister to France, fellow-passengers with Professor Morse and Doctor Jackson in the *Sully* in 1832, and Captain William Pell, chief officer of the vessel, gentlemen to whom Doctor Jackson confidently ap-

pealed to confirm his claims to the originality of the idea of the new telegraph, did not remember any person in connection with the discovery and invention but Professor Morse. (See note, p. 65.)

After Professor Morse received Doctor Jackson's letter of the seventh of November, 1837, in which the latter attributed to Mr. Rives or Mr. Fisher the first suggestion of sending news by electricity, he — Prof. Morse — wrote another letter to Mr. Fisher, dated November 14th, 1837, in which he propounded the following questions, viz.: —

"*First.* Do you recollect having made the observation attributed either to you or to Mr. Rives?

"*Second.* Have you any impression, from your recollection of what occurred on board the *Sully*, that any other person than myself was the inventor of the electric telegraph?"

On the seventeenth, Mr. Fisher answered to the first inquiry, "Certainly not; and it would have been strange, if not silly, to have done so, since the *first mention* of an electric or galvanic telegraph *by you* implied the possibility."

To the second, he answered, "I had no idea that any of our fellow-passengers could claim the credit of it. I am quite sure I received my first idea of it from *you;* that you were most interested in it; that *you alone* seemed inclined to test its practicability after landing," etc.

Professor Morse also wrote to Mr. Rives making similar inquiries, and received an answer, dated March 1st, 1838, in which that gentlemen says: —

"I am utterly surprised that any one should have given me credit for suggesting it. I am perfectly sure that such a conception had never entered my mind, and that it was a complete novelty to me when first presented to my contemplation *by your conversations* during the progress of the voyage above mentioned. Wishing you, my dear sir, great success in maturing and carrying into execution an invention which promises to mark a new era in the progress of improvements, I remain," etc.

This letter was written by Mr. Rives some months after Dr. Jackson wrote to him claiming that *he* was the inventor, and asking a statement to that effect.

On the 20th of January, 1838, Professor Morse again wrote to

Captain Pell, with the view of establishing the originality of his invention against Dr. Jackson's claim. In his reply, dated February 1st, 1838, Captain Pell said: —

"It is a matter of great astonishment to me, that a fellow-passenger with us in the *Sully* from Havre, in October, 1832, should attempt to contest with you the claim of having been the inventor of the electric telegraph, which occupied so much of your attention during the passage, or that there was one on board of her who had any claim to even a participation of its honors. . . .

"My impressions rest upon my mind with the freshness and force of conviction, that *you only* on board of that ship was the originator of the invention; that *your mind alone* seemed interested in it with any seriousness of purpose, even after its first suggestion by you; and while it was, in seeming, the daily and favorite object of your study, which was each day developing it into a higher perfection.

"So, when a few days since I examined your instrument, I recognized in it the principles and mechanical arrangements which on board I had heard you so frequently explain through all its developments. With the sincere wish that no hand may be so rash as to persist in the attempt to snatch from you the reward which belongs to you, I subscribe myself," etc.

While in Paris, in 1839, Professor Morse received intelligence that Dr. Jackson had set up a claim to his *entire invention;* and having ascertained that one of the Palmers resided at Rahan, in Ireland, he addressed him a letter, dated Paris, February 22d, 1839, from which the following is an extract, viz.: —

"Please to designate whom you believe to be the *inventor*. *Have you any idea that any other person on board that ship could claim to be the inventor, or to be a participator in the invention of the Electro-Magnetic Telegraph, as there planned?* My object in requesting an answer to this question is to defend myself against a claim just publicly made by *one of our fellow passengers*, who, since the anoucement of the success of this invention, has boldly attempted to deprive me of the 'entire invention.'"

Mr. Palmer replied, under date of March 5th, 1839, and, among other things, said: —

"I pefectly recollect your describing to myself and other of our fellow-passengers on board the *Sully*, during her homeward passage from Havre to New York, in 1832, an electric telegraph, which you stated you had invented, or which had occurred to you since your being on board.

"It was certainly new *to me*, and to the best of my knowledge and belief was so also to the rest of our fellow-passengers; for (if my memory does not betray me) no one at that time claimed a priority of invention in your method of applying the electric fluid to the conveying of dispatches. I certainly did understand at the time that you intended to perfect this invention, which you considered your own, and to obtain a patent for it."

Mr. Fisher, in reply to Dr. Jackson's letter of June 6th, 1847, among other things, said: —

"Whoever first started the idea, he (Morse) at once embraced it, and by dint of his inquiries, and by the aid he solicited from others, was able to carry it to perfection. Without your assistance, or that of others equally accomplished in the sciences, he in all probability would have been unable to proceed, but would have ridden it as a hobby-horse with as little progress as an infant in his. But the praise must be his, of seeking, wherever he could find it, the science and mechanical skill which previously he had not, and using them in prosecuting his favorite scheme."

Mr. Fisher was required to give his deposition in the Kentucky case of Morse et al. *vs.* O'Reilly et al., and on that occasion stated under oath that he wrote the letters to Professor Morse, above quoted, dated September 21 and November 17, 1837; that he "then believed, and still believes the matters therein stated to be true; that neither Dr. Jackson nor any other passenger, except Professor Morse, was engaged on board of that ship in planning or devising any machine or telegraphic instrument, or the mode of communicating intelligence by telegraph;" that "Professor Morse's mind, and his only, seemed to be engaged in that subject, and that intensely;" that Dr. Jackson did not, to his recollection, "on board of the packet-ship *Sully*, or elsewhere, give any minute or any description of the appropriate, or of any means, or of any instrument, by which news might be communicated by galvanic electricity, or by electro-magnetic machinery;" that, to "the best

of his recollection, Dr. Jackson did not, on board the *Sully*, describe any mode of telegraph communication." In fine, nothing could be more directly confirmed than Morse's claim is by this deposition.

In his deposition in the same suit, Captain Pell states on oath that he "believed, and still believes, that the matters stated by him, in his letters to Professor Morse, dated on the 27th September, 1837, and 1st February, 1839, to be true;" that he "does not know any other passenger or person who returned with Professor Morse, on board the ship *Sully*, in October, 1832, who discovered, or invented, or who communicated the discovery or invention of an Electric Telegraph, claimed to have been discovered by Professor Morse;" that, during the passage, "he did not hear, nor did he understand, that any other person on board the said ship, except said Morse, pretended to claim to have made said discovery;" that neither Dr. Jackson, nor any other passenger except Morse, to his knowledge, "made any claim in regard to the matter, as being the inventor, or as having any part in it, or as taking any such part or prominence in the said discussions as would make him out as a participator in the invention;" that "he always has believed, and still does believe, that Professor Morse was the first person, and the only person on board the packet-ship *Sully*, who suggested the Electric Telegraph, and that he alone among the passengers brought it to its maturity."

And the Hon. W. C. Rives, at present Minister to France, declared, on the eve of his departure, that he was ready, on any proper occasion, to confirm on oath the truth of his letters to Professor Morse, dated September 21st 1837, and March 1st, 1838.

Dr. Jackson answered the circular letter of Professor Morse on September 10th, 1837, in which he claimed to be mutual inventor of the telegraph, and says, among other things: "In the application of the electro-magnet I had proposed to mark in actual type, having a packet of twenty-four wires for the conductors to the several magnets, each of which moved a letter and pressed with great power." He says, "I have drawings of several instruments, and hope next winter to make public trials of the experiments, and shall not publish anything until the work is done and

perfected." . . . "I suppose that the reason why my name was not attached to the invention of the electric telegraph is simply that the editor did not know that the invention was our mutual discovery. I trust you will take care that the proper share of credit shall be given me when you make public all your doings."

To this Professor Morse replies: —

"New York, City University, September 18, 1837.

"To Dr. Charles T. Jackson: —

"My Dear Sir, — Yours of the 10th instant, from Bangor, I have received, and I lose no time in endeavoring to disabuse your mind of an error into which it has fallen in regard to the electro-magnetic telegraph. You speak of it as 'our electric telegraph,' and as 'a mutual discovery.' I am persuaded that when you shall recall the circumstances as they occurred on board the ship, and shall also be informed of the nature of the invention of which I claim to be the sole and original inventor, you will no longer be surprised that your name was not connected with mine in the late announcement of the invention. I have a distinct recollection of the manner, the place, and the moment when the thought of making an electric wire the means of communicating intelligence first came into my mind and was uttered. It was at the table in the cabin, just after we had completed the usual repast at mid-day; you were upon one side of the table, and I upon the other. We were conversing on the recent scientific discoveries in Electro-Magnetism, and the experiments of Ampère with the Electro-Magnet; you were describing the length of wire in the coil of a magnet, and the question was asked by one of the passengers if the electricity was not retarded by the length of wire. You replied, no; that electricity passed instantaneously over any known length of wire, and you then alluded in proof to the experiment by Dr. Franklin, who had made manymiles in circuit near (London) Philadelphia, to ascertain the velocity of electricity, but could observe no difference of time between the touch at one extremity and the spark at the other. I then remarked, this being so, if the presence of electricity can be made visible in any desired part of the circuit, I see no reason why intelligence might no be transmitted instantaneously by electricity. You gave your assent that it was possible. The conversation

was not diverted by this remark of mine from the details of the experiment you were describing, which was the obtaining of a spark from a magnet, nor was this thought of the telegraph again mentioned, until I introduced the subject the next day. While your own mind was, during the voyage, more occupied with other branches of science, geology and anatomy, the thought which I had conceived took firm possession of my mind, and, as you well know, occupied the wakeful hours of the night; for I used to report occasionally to you and to several of the other passengers my progress, and to ask you questions in regard to the best mode of ascertaining the presence of electricity. I had devised a system of signs and constructed a species of type, which I drew out in my sketch-book, by which to regulate the passage of electricity, but I had not settled the best mode of causing the electricity to mark. Several methods suggested themselves to me, such as causing a puncture to be made in a paper by the passage of a spark between two disconnected parts, etc., which I soon discarded as impracticable. I asked you if there was not some mode of decomposition which could be turned to account. You suggested the following experiment, which we agreed should be tried together, if we could meet for that purpose. It was this: to decompose, by the electricity, glauber salts upon the paper, which was first to be covered with turmeric. This to me seemed so simple and easy a mode that I fell in with the idea, and we agreed to try this experiment as soon as possible after our landing. In my occasional visits to Boston, since my return from Europe, I have always endeavored to see you, and never saw you, as you well know, without introducing the subject of the telegraph, and expressing a wish that the experiment we had talked of might be tried. You were always otherwise busily and necessarily engaged, and the experiment was never tried. I really do not see the ground of your claim to be a mutual discoverer, even if we had tried the experiment proposed, and it had been successful. This fact would not have constituted you a mutual discoverer, but it might have made you a partner, in a certain sense, of the invention. The discovery is the original suggestion of conveying inteligence by electricity. The invention is devising the mode of conveying it. The discovery, so far as we alone are concerned,

belongs to me, and it must of necessity belong exclusively to me; and if, by an experiment which we proposed to try together, we had mutually fixed upon a successful mode of conveying intelligence, then might we with some propriety be termed mutual or joint inventors. But as we have neither tried any experiment together, nor has the one proposed to be tried by you been adopted by me, I cannot see how we can be called mutual inventors. You are not aware, perhaps, that the mode I have carried into effect, after many and various experiments, with the assistance of my colleague, Professor Gale, was never mentioned, either by you or to you. The plan of marking by my peculiar type, and the use which I make of the electro-magnet, was entirely original with me; all the machinery has been elaborated without a hint from you of any kind, in the remotest degree. I am the sole inventor; indeed, had you been aware of these facts, I am sure you would not have preferred a claim to be co-inventor in an instrument wholly mine. You say, 'I trust that you will take care that the proper share of credit shall be given to me when you make public your doings.' This I have always done, and with pleasure. I have always given you credit for great genius and acquirements, and have always said, in giving my account of my telegraph, that it was on board the ship, during a scientific conversation with you, that I first conceived the thought of an electric telegraph. Is there really any more you will claim, or that I could in truth or justice give? I have acknowledgments of similar kinds to make to Professor Silliman and Professor Gale, to the former of whom I am under the same obligations, in kind and degree, as to yourself; and to the latter I am most of all indebted for substantial and effective aid in many of my experiments. If any one has a claim to be mutual inventor on the score of aid by hints, it is Professor Gale; but he prefers no claim of the kind. I certainly have no cause to complain because you were never at leisure, when I was in Boston, to try the experiment which we agreed together to try; but you will see in a moment that I should have just reason to complain if, after repeated disappointments in this respect, and after having availed myself of a different method, one entirely my

own, to carry into effect my original invention, you should prefer a claim to partnership in it, because we had once conferred together on an experiment never tried."

. . . .

"Believe me, dear sir,
"Truly your friend and servant,
"SAMUEL F. B. MORSE."

Dr. Jackson's Answer.

"BOSTON, November 7, 1837.

"SAMUEL F. B. MORSE: —
"MY DEAR SIR, ...
I will confine my remarks to the invention made on board the *Sully*. You say that you 'have a distinct recollection of the manner, time, and place, and the moment when the thought of making an electric wire the means of communicating intelligence first came into your mind and was uttered.' If you have this vivid recollection, you cannot refuse your assent to the following remarks, for I remember too, and am happily endowed with a strong and retentive memory as to the facts. In the first place, you will acknowledge that you were at that time wholly unacquainted with the history and management of electricity and electro-magnetism, while I was perfectly familiar with the subject, it having been one of my favorite studies from boyhood to the present hour, and I had enjoyed every possible advantage in acquiring a full knowledge of the subject during my studies in the scientific schools of Paris and elsewhere. Now, in what manner did the discovery and invention arise, and to whom are the suggestions due? I was enthusiastically describing the curious and wonderful properties of electricity and electro-magnetism before yourself, Mr. Rives, Mr. Fisher, and others, at the table after dinner, while the company were all listeners, and, as appeared to me, were somewhat incredulous, they knowing little or nothing of the subject. I mentioned, among other things, that I had seen the electric spark pass instantaneously, without any appreciable loss of time, four hundred times around the great lecture-room of the Sorbonne. This evidently surprised

the company, and I then asked if they had not read of Dr. Franklin's experiment, in which he caused electricity to go a journey of twenty miles by means of a wire stretched up the Thames, the water being made a portion of the circuit?

"The answer was, from yourself, that you had not read it. After a short discussion as to the instantaneous nature of the passage, one of the party, either Mr. Rives or Mr. Fisher, said it would be well if we could send news in the same rapid manner; to which you replied, 'Why can't we?' I then proceeded to inform you, in answer to your questions, how it might be done:—

"1st. I observed that electricity might be made visible in any part of the circuit by dividing the wire, when a spark would be seen at the intersection.

"2d. That it could be made to perforate paper if interposed between the disconnected wires.

"3d. Saline compounds might be decomposed so as to produce colors on paper.

"The second and third projects were finally adopted for a future trial, since they could be made to furnish permanent records. The saline substances mentioned were, certain salts of lead, such as the acetate and carbonate, which an interrupted electro-galvanic current would decompose, and leave a black mark on the prepared paper.

"Next turmeric paper was to be dipped in a neutral salt, say sulphate of soda, and then acted upon by a galvanic current. This would produce brown marks, from the presence of the disengaged alkali. Platina points were proposed to effect the changes of color.

"You then questioned me again on every point of the conversation, and said you had been thinking much about it, and, pencil in hand, proposed a method of deciphering the marking, the dots and marks being made regularly. This was a subject of discussion, and we both took part in it, but I acknowledge that you did most in planning the numeration of the marks. You at first proposed 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, and subsequently reduced the number to five figures and a 0. Now, as to the invention, I beg leave to remark that I knew every experiment mentioned, from my own frequent practice in making them. It was to me no unwrought problem, but a matter of absolute certainty. I was not

making conjectures, but repeating the facts of chemical and physical science. Hence, since I have performed all the experiments in detail, and here brought together for a special purpose, I was, so far as they are concerned, the true inventor, and I do claim to be the principal in the whole invention made on board the *Sully*. It rose wholly from my materials, and was put together at your request by me. This you certainly will not pretend to dispute. I give you full credit for your ingenious suggestions as to the divisions in the markings, which you certainly did propose.

"You will not, I presume, venture to maintain that you at that time knew anything about electro-magnetism, more than what you learned from me. If I wanted any other proof beyond your own confession, I should only have to recall to mind your futile attempt, after your arrival in New York, at making a galvanic battery, and the plan of types, levers, etc., which were wholly impracticable, and demonstrated to me that you did not understand the subject.

"I have searched the archives of science, and find that the first idea of such an instrument was conceived by Soemmering, who proposed an electro-magnetic telegraph. Oersted, of Copenhagen, also invented one. Ampère says, it is easy to construct an electro-magnetic telegraph. See Ampère, Exposé des Nouvelles Decouvertes sur l'Electricité et le Magnetisme. Paris, 1822, page 71.

"The discovery is not, then, to be claimed by us.

. . . .

"Most respectfully your friend,
"C. T. JACKSON.

"P. S. I did not read this in Ampère until three years since, although I have owned the book since 1832, and when I saw you last I forgot to mention to you that he had conceived the idea of such a telegraph. I had read portions of the book before, but not that section."

Professor Morse's Second Rejoinder.

"New York City University,

"Dec. 7, 1837.

"To Dr. Chas. T. Jackson:—

"Dear Sir,— . . . .
Your memory and mine are at variance in regard to the first suggestion of conveying intelligence by electricity. I claim to be the one who made it, and in the way which I stated in my letter to you. You acknowledge that the suggestion was made by one of the company, and not by yourself, and so doubtful are you by whom it was made, that, although your memory serves you up to the point of giving it to one of two others rather than to me, yet your memory then fails, and you do not know which of the two it was. Now, sir, it was neither Mr. Fisher nor Mr. Rives who suggested that thought. I suggested it, and in consequence proceeded to found upon it my whole invention. Had not the thought been original with me, I could not have dwelt upon it with any satisfaction. The idea that I had made a brilliant discovery, that it was original in my mind, was the exciting cause, and the perpetual stimulus to urge me forward in maturing it to a result. Had I supposed at that time that the thought had ever occurred to any other person, I could never have pursued it; and it was not till I had completed my present invention, that I was aware that the thought of conveying intelligence by electricity had occurred to scientific men some years before. The thought was suggested to my mind by a well-known fact, recalled to my memory in your account of a magnetic experiment,—the experiment of Franklin on the velocity of electricity.

. . . .

"After having given my suggestion to another, you make me answer it by asking you, 'Why can't we?' and to this question you represent yourself as having immediately given a methodical answer, which implies that the whole idea of an electric telegraph was then not only perfectly familiar with you, but that the modes of carrying it into execution were also as familiar as any common chemical experiment. Now, if your memory is good, you must e conscious that this is altogether incorrect; that it is impossi le that it should be correct, since the very thought was new to all,

and required at least a little time to devise modes of carrying it into effect. You must be sensible that my suggestion of the possibility of conveying intelligence by electricity was episodical; it did not change the current of your remarks from electro-magnetism, upon which you were discoursing, nor did you make a remark concerning a telegraph, until I called your attention to it the next day; as the thought was suggested by me, so it dwelt in my mind. I cherished it as an antidote to ennui, maturing my invention principally in the sleepless hours of the night. With this invention I was so absorbed that I thought of little else, and I was in the habit of reporting progress almost daily to the captain, and to several of the other passengers beside yourself. To you, as a man in whom I thought I could confide, I more especially explained my plan of numbers, intervals, types, etc., and the machinery for using them.

"I had already invented these, and was reviewing in my mind the various modes of marking at least ten days after my first thinking of the subject, when I consulted you to ascertain if there were not some substance easily decomposed by a simple contact of a wire in an electric state. It was then, and not till then, that you suggested turmeric paper, dipped in a solution of sulphate of soda. It was then, and not till then, that you took any interest in the invention. I proposed to you to try this experiment with me when we should arrive at home, and here, sir, is the origin of your error, in thinking yourself entitled on this account to be a co-inventor. This experiment we were to try together, and if you had tried it, and had otherwise aided me in the invention, I should have been willing to share both honors and profits with you. But you very well know you never tried this nor any other experiment in relation to the telegraph, which you ever reported to me.

. . . .

"Thus it has been for nearly five years. You must be aware, too, that while you considered my invention as impracticable, you did not suggest a single hint of any other mode of applying it. You spoke of my invention of numerals, intervals, levers, type, etc., which I had drawn out in my sketch-book, as ingenious, but impracticable; indeed, in your last letter you assert that my mode of permanently recording is impracticable, and that you corrected

my errors. How you corrected my errors, you don't say, nor what mode you proposed as a substitute. If you did propose any, you can doubtless tell what it is.

. . . .

"I deny that I am indebted to you for any single hint of any kind whatever which I have used in my invention.

. . . .

"My invention on board the *Sully* is mechanical and mathematical; it had no more to do with chemical science than with geology or anatomy. The single scientific fact ascertained by Franklin, that electricity can be made to travel on a conductor any distance, instantaneously, is all that I needed to know, aside from mathematics and mechanical science, in order to plan all I invented on board the ship, as any one will be able to see from a moment's inspection of my machinery, as there planned. This machinery consisted chiefly, as you well know, of a system of signs, which were numerals, to be read by intervals, type, and apparatus to arrange the numbers for transmission, a lever to mark on the register by closing and breaking the circuit, and a register moving by clock machinery to receive the marks at the proper time. So much of the invention, at least, you very properly concede to me.

"The apparatus which I invented on board the *Sully* was gradually matured, and was constructed for and adapted to the use of one wire, or a single circuit. Now, this you have often asserted to me to be impracticable; and, although you never devised, to my knowledge, any other method, until I informed you of mine with an electro-magnet, you now talk in your letters of using twenty-four wires and twenty-four magnets, and of marking in real type. Now, what have these to do with my invention on the *Sully?* The use of twenty-four wires was probably adopted by you from a hint of mine in the very outset, for it was my first and most natural thought; but having devised what I considered a much more simple and less expensive mode, to wit, using one wire, I almost immediately relinquished the first for my new mode; whether you derived the hint from me or not is to me of little consequence, for, provided you use nothing that was invented by me, upon the packet of twenty-four wires, you are at liberty to use them as you please. If you have invented a telegraph of twenty-four wires, and a mode

of marking in 'real type,' why do you claim to be a mutual inventor of mine, which is adapted to one wire or a single circuit, and which you at the same time pronounce 'impracticable'? Your claim to any share in my impracticable mode, is, to say the least, very singular. Unfortunately for the sustainment of your claim, the plan which I devised on board the ship, the plan of numerals, types, lines, etc., which you pronounce wholly impracticable, and the use of one wire or a single circuit which you pronounce im practicable, is the only plan I have now in successful operation.

. . . .

"Your most obedient servant,

"SAMUEL F. B. MORSE."

Kendall's "Full Exposure," etc., 1850.

From these letters and from depositions in substantial accord with them, the incidents that occurred on board the Sully and subsequently, specially bearing upon the invention of the telegraph, may be thus stated.

In an after-dinner conversation among the cabin passengers and chief officer of the packet ship, the subject of the recent discovery by Faraday of the means of obtaining a spark from a magnet, and the great facts of electro-magnetism and magneto-electricity were introduced. Dr. Jackson entertained the company with an enthusiastic account of experiments he had witnessed in Paris, among the rest mentioning as an illustration of the great velocity of the electric current, its transmission four hundred times around the hall of the Sorbonne without the consumption of appreciable time. At this point the brilliant thought occurs to Professor Morse, to which he gives expression, that this agent might be employed to convey intelligence through great distances. Dr. Jackson responds that there is no doubt about it, and resumes his account of experiments he had witnessed, not further disturbed by the interjectional remark of Professor Morse. Nothing was said of a telegraph by any one.

Now, the next morning, Professor Morse mentions to Dr. Jackson that he had been occupied much of the night with the idea of an electric telegraph.

In the conversation that followed it may be assumed that the three methods mentioned by Dr. Jackson in his letter of Nov. 7, 1837, were discussed between them. Professor Morse remembers to have mentioned one of them. As given by Dr. Jackson they are as follows: —

"1st. I observed that electricity might be made visible in any part of the circuit, by dividing the wire, when a spark would be seen at the intersection.

"2d. That it could be made to perforate paper if interposed between the disconnected wires.

"3d. Saline compounds might be decomposed, so as to produce colors on paper."

If we now turn to Enfield's *Institutes of Natural Philosophy*, the text-book which was experimentally illustrated by Professor Day at Yale College when Professor Morse was an undergraduate, published in 1802, in proposition XXI., chap. 5, book 1, we find the following: —

"If the circuit be interrupted, the fluid will become visible, and when it passes it will leave an impression upon any intermediate body.

"Exp. 1. Let the fluid pass through a chain or through any metallic bodies placed at small distances from each other. The fluid will be visible between the links of the chain or between metallic bodies.

"Exp. 2. If the circuit be interrupted by several folds of paper, a perforation will be made through it, and each of the leaves will be protruded by the strokes from the middle to the outward leaves.

"Exp. 3. Let a card" (cards are usually glazed with a preparation of lead salts) "be placed under wires which form the circuit, when the circuit is interrupted for the space of an inch, the card will be discolored. Cavallo says, cards glazed with white lead were marked by a long black track."

It will be seen on comparison that the three methods given in the one are but the transcript of the three classes of experiments in

the other, and that they involve the application of frictional electricity only. They were mentioned by Cavallo and Lullin in the last century, and Reusser applied, in 1794, the principle illustrated in the first experiment of Enfield, in his plan of the electric-telegraph already referred to, and Boeckman applied the method of counting the sparks in his plan of an electric-telegraph, in 1795.

Now, following this interview, several days elapsed, during which, up to this time, if credit was really due to anybody, it was to the author of the interjectional remark suggesting the use of electricity for the conveyance of intelligence, and he was Professor Morse. Both Morse and Jackson (see Jackson's letter *supra*) seem at this time to have been ignorant that this use of electricity, either frictional or voltaic, had ever before been made by any one.

Professor Morse at the outset conceived the mathematical and mechanical elements of his method of recording. After some ten days from the first conversation at the dinner-table, Professor Morse asked Dr. Jackson if he knew of a chemical preparation with which paper might be saturated, and which the electric current would decompose, leaving a permanent discoloration of the paper. Dr. Jackson replied with the suggestion that paper might be saturated with sulphate of soda and turmeric which, on the electric spark passing from one platinum point to another through the paper, would, by decomposition of the sulphate of soda, setting the soda free, color the turmeric brown. It was agreed that an experiment should be made to ascertain whether this preparation would yield the desired permanent discoloration. Professor Morse, at the time, explained to Dr. Jackson his method of so interrupting the electric current as to produce dots, lines and spaces at measured and determined intervals, which should stand for numerals, and which developed into the alphabet.

It was in memory of the incidents of this interview that Dr. Jackson wrote, following the three methods given above: —

"The second and third projects were finally adopted for future trial since they could be made to furnish permanent records. The saline substances mentioned were certain salts of lead, such as the acetate and carbonate, which an interrupted galvanic current would

decompose and leave a black mark on the paper. Next turmeric paper was to be dipped in a neutral salt, say sulphate of soda, and then acted upon by the galvanic current. This would produce brown marks from presence of free disengaged alkali. Platina points were proposed to effect the changes in color. I then observed that it would be easy to devise a method of reading the markings.

"Here the conversation changed for a while, and was resumed by you the next day after breakfast. You then questioned me again on every point of the invention, and said that you had been thinking much about it, and, pencil in hand, proposed a method of deciphering the markings, the dots and marks being made regularly.

"This was a subject of discussion, and we both took part in it, but I acknowledge that you did most in planning the numeration of the marks. You at first proposed 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, and subsequently reduced the number to five figures and a 0." . . . "I give you full credit for your ingenious suggestions as to the divisions in the markings, which you certainly did propose."

This method so far conceived was manifestly at the best a plan for a purely electro-*chemical* telegraph, and in no sense whatever an electro-*magnetic* telegraph. The experiments which were to have been made were never carried out, and the invention, so far as Morse was concerned, was never brought into successful operation.

The *electro-MAGNETIC telegraph*, which Morse also conceived, and the devices for which he elaborated and committed to paper on board the Sully, was in the course of the voyage shown to the various passengers, and among the rest to Dr. Jackson, and condemned by him as impracticable, in the following terms. (See letter above cited.)

. . . "I should only have to recall your futile attempt after your arrival in New York, at making a galvanic battery, and the plan of types, levers, etc., which were wholly impracticable, and demonstrated to me that you did not understand the subject."

This invention, thus admitted to be Morse's, and denounced by Jackson, was the ultimately successful Morse recording telegraph.

In conclusion, in view of the whole literature on the claim of Dr. Jackson, it may be said that but for the after-dinner conversation on the *Sully*, the Morse recording telegraph would not, in all probability, have been invented on this voyage. It may perhaps be further said that but for the enthusiasm with which Dr. Jackson described the brilliant experiments he had witnessed, Morse's telegraph might have been, probably would have been, delayed — possibly never have been conceived. But it is impossible to admit, after Morse's first suggestive inquiry, that the recalling in a subsequent conversation of the familiar experiments with frictional electricity mentioned in Enfield's Philosophy, — assuming them to have been reproduced wholly from Jackson's memory, which is not the fact, — could fairly be said to contain the suggestion of the Morse recording telegraph. Jackson concedes substantially the invention of the alphabet to Morse, and it is not fair to award a share in this invention, because in response at a still later period to an inquiry of Professor Morse for a chemical preparation, sensitive to change in color under the decomposing effect of electricity, he should have named a preparation which subsequent experiment proved to be without value for the purpose required. Nor is it proper that Jackson should share in the credit of the successful development of the electro-*magnetic* telegraph (involving this alphabet), the practicability of which he takes credit to himself for having denounced at the time of its description to him by Professor Morse.

It may, however, be fairly credited to Dr. Jackson that in the conversation on the *Sully* he was instrumental, as a lecture, or the perusal of a brilliant article in a journal might have been, in awakening a train of thought in the mind of Professor Morse that has been fruitful in services to civilization, with which any one may be gratified to be justly connected.

APPENDIX C.

The originality of Professor Morse, as the inventor of the subjects claimed in this patent of 1840.

St. George T. Campbell, in his argument before the Supreme Court, 1852, remarks as follows: —

"The investigation of this subject is one of immense scope. It has been four times judicially examined by the courts of the United States, and four times by the Patent Office, and in every instance decided in favor of Morse."

Morse's originality was investigated by the Commissioner of Patents when he issued this patent in 1840, when he reissued the patent in 1846, and when he reissued it again in 1848. It was reported upon by the Examiner in the present application. Judge Woodbury, at Boston, Judge Munroe, in Kentucky, Judges Grier and Kane, at Philadelphia, and finally the Supreme Court of the United States have investigated it. Seldom has a question of fact been more thoroughly weighed.

The conclusion to which commissioners, examiners, and justices have arrived, may be briefly summed up in the language of

Chief Justice Taney, *in expressing the unanimous* opinion *of the* Supreme Court of the United States on this point.

"Waiving, for the present, any remarks upon the identity or similitude of these inventions, the Court is of opinion that the first branch of the objection cannot be maintained, and that Morse was the first and original inventor of the telegraph described in his specification, and preceded the three European inventions relied on by the defendants.

"The evidence is full and clear that when he was returning from a visit to Europe, in 1832, he was deeply engaged upon this subject during the voyage; and that the process and means were so

far developed and arranged in his own mind, that he was confident of ultimate success. It is in proof that he pursued these investigations with unremitting ardor and industry, interrupted occasionally by pecuniary embarrassments; and we think that it is established by the testimony of Professor Gale and others, that early in the spring of 1837 Morse had invented his plan for combining two or more electric or galvanic circuits, with independent batteries, for the purpose of overcoming the diminished force of electro-magnetism in long circuits, although it was not disclosed to the witness until afterwards; and that there is reasonable ground for believing that he had so far completed his invention, that the whole process, combination, powers, and machinery, were arranged in his mind, and that the delay in bringing it out arose from his want of means; for it required the highest order of mechanical skill to execute and adjust the nice and delicate work necessary to put the telegraph into operation, and the slightest error or defect would have been fatal to its success. He had not the means at that time to procure the aid of workmen of that character; and without their aid no model could be prepared which would do justice to his invention; and it moreover required a large sum of money to procure proper materials for the work. He however filed his caveat on the 6th of October, 1837, and on the 7th of April, 1838, applied for his patent, accompanying his application with a specification of his invention, and describing the process and means used to produce the effect." . . . .

"With this evidence before us, we think it is evident that the invention of Morse was prior to that of Steinheil, Wheatstone or Davy. The discovery of Steinheil, taking the time which he gave himself to the French Academy of Science, cannot be understood as carrying it back beyond the months of May, or June, 1837, and that of Wheatstone, as exhibited to Professors Henry and Bache, goes back only to April in that year. And there is nothing in the evidence to carry back the invention of Davy beyond the 4th of January, 1839, when his specification was filed, except a publication said to have been made in the London Mechanic's Magazine, January 20, 1838; and the invention of Morse is justly entitled to take date from early in the spring of 1837. And in the description of Davy's invention, as given in the publication of

January 20, 1838, there is nothing specified, which Morse could have borrowed; and we have no evidence to show that his invention ever was or could be carried into successful operation.

"Now we suppose no one will doubt that Morse believed himself to be the original inventor when he applied for his patent, in April, 1838. Steinheil's discovery does not appear to have been patented until after Morse's application for a patent, nor to have been patented until after Morse's previous publication, or to embrace any substantial part of his invention. And if his application for a patent was made under such circumstances, the patent is good, even if in point of fact he was not the first inventor.

"In this view of the subject, it is unnecessary to compare the telegraph of Morse with these European inventions to ascertain whether they are substantially the same or not. If they were the same in every particular, it would not impair his rights. But it is impossible to examine them, and look at the process and the machinery and results of each, so far as the facts are before us, without perceiving at once the substantial and essential difference between them, and the decided superiority of the one invented by Professor Morse.

"Neither can the inquiries he made, nor the information or advice he received from men of science in the course of his researches, impair his right to the character of an inventor. No invention can possibly be made, consisting of a combination of different elements of power, without a thorough knowledge of the properties of each of them, and the mode in which they operate on each other. And it can make no difference in this respect whether he derived his information from books or from conversation with men skilled in the science.

"If it were otherwise, no patent in which a combination of different elements is used could ever be obtained. For no man ever made such an invention without having first obtained this information, unless it was discovered by some fortunate accident. And it is evident that such an invention as the electro-magnetic telegraph could never have been brought into action without it. For a very high degree of scientific knowledge, and the nicest skill in the mechanic arts, were combined in it, and were both necessary to bring it into successful operation. And the fact that Morse sought

and obtained the necessary information and counsel from the best source, and acted upon it, neither impairs his rights as an inventor, nor detracts from his merits."

DICISION OF JUDGES KANE AND GRIER.

United States Circuit Court, District of Pennsylvania, 1851.

The trial in this important and interesting case occurred in Philadelphia, in September, 1851, involving important questions relative to the originality of the inventions claimed by Professor Samuel F. B. Morse. The plaintiffs, who represent the Magnetic Telegraph Company using Morse's patents, allege that the defendants, who represent the "Bain Line" from Washington to New York, have violated the patents granted to Morse.

The judges on the bench were the Hon. R. C. Grier and Hon. J. K. Kane.

On the 3d of November, Judge Kane delivered the opinion of the court, Judge Grier expressing his concurrence therein.

Opinion of the Court. — This case is before us on final hearing upon the pleadings and proofs.

. . . .

Mr. Morse's patent of 1840, in all its changes, asserts his title to two distinct patentable subjects; the first, founded on the discovery of a new art; the second, on the invention of the means of practising it.

That he was the first to devise and practise the art of recording language at telegraphic distances, by the dynamic force of the electro-magnet, or, indeed, by any agency whatever, is, to our minds, plain upon all the evidence. It is unnecessary to review the testimony for the purpose of showing this. His application for a patent in April, 1838, was preceded by a series of experiments, results, illustrations, and proofs of final success, which leave no doubt whatever but that his great invention was consummated before the early spring of 1837. There is no one person, whose invention has been spoken of by any witness referred to in any book, as involving the principle of Mr. Morse's discovery, but must yield precedence of date to this. Neither Steinheil, nor Cooke and Wheatstone, nor Davy, nor Dyar, nor Henry, had at

this time made a recording telegraph of any sort. The devices then known were merely *semaphores*, that spoke to the eye for the moment, — bearing about the same relation to the great discovery now before us as the Abbe Sicard's invention of a visual alphabet for the purposes of conversation bore to the art of printing with movable types. Mr. Dyar's had no recording apparatus, as he expressly tells us; and Professor Henry had contented himself with the abundant honors of his laboratory and lecture-rooms.

When, therefore, Mr. Morse claimed, in his first specification, "the application of the electro-magnet," "for transmitting by signs and sounds, intelligence between distant points," and "the mode and process of recording or making permanently signs of intelligence transmitted between distant points;" and when in his second specification he claimed "the making use of the motive power of magnetism, when developed by the action of currents of electricity, as a means of operating and giving motion to machinery, which may be used to imprint signals upon paper or other suitable material," "for the purpose of telegraphic communication;" characterizing his "invention as the first recording or printing telegraph by means of electro-magnetism;" and when in his third, after again describing his machinery and process, he once more characterized it in the same terms, and claimed "as the essence of his invention the use of the motive power of the electric or galvanic current (electro-magnetism as he now terms it), however developed, for marking or printing intelligible characters, signs of letters at any distance;" through these several forms of specification, claiming and renewing his claim of property in the same invention, as it seems to us, — and claiming in each and in all of them no more, as it also seems to us, than he was justly entitled to claim, — he declared the existence of a new art, asserted his right in it as its inventor and owner, and announcing fully its nature and elements, invoked in return the protection of the laws.

From this time his title was vested as patentee of the art, and other men became competitors with him only in the work of diversifying and perfecting its details. He himself used the *stylus* to impress paper or parchment, or wax-coated tablets, it may be; though he sometimes made a colored record by the friction of a pencil; another substitutes a liquid pigment, or stains his paper

with a chemical ink; the next perhaps stains his paper beforehand, and writes on it by decomposing the coloring matter; and another, yet more studious of originality than the rest, writes in a cyclovolute, instead of a straight line, and manufactures his ink as he goes along, by decomposing the tip of his stylus on a chemically moistened paper. They are, no doubt, all of them inventors; as was the man who first cast types in a mould, or first bent metal into the practical semblance of the gray goose-quill, or first devised sympathetic ink, that the curious in letter-writing might veil their secrets from the profane. All these toiled ingeniously and well to advance and embellish a pre-existing art. But they had no share in the discovery of the art itself, and can no more claim to share the property which its discovery may have conferred on another, than he who has devised some appropriate setting for a gem can assert an interest in the gem itself.

Yet admitting, for the sake of argument, that Mr. Morse's leading invention is correctly designated as a new art; and that he has sought to patent it accordingly, by a compliance with all the requisitions of the statute, — it is still contended, and with much of elegant research into the radical meaning of the term, that an art, as such, cannot be made the subject of a patent. But interpreting language as men use it around us and as it reflects ideas, the question can hardly be regarded as doubtful. The constitutional provision under which our patent laws are framed, looks to the promotion of "useful arts." The act of Congress places "a new and useful art" among the discoveries it professes to protect, and assigns it to the first place on the list. The statute of 21 James I., c. s., from which the patent system of England has grown up, speaks only of "new manufactures." Yet the judges in that kingdom find a warrant in this limited expression for sustaining patents for an art, and even for the renewed discovery of an art that had been lost. (See the Hot Blast case, *Webster*, *P. C.*, 683, 717, and Mr. Webster's note at p. 718, and the case of Wright's patent, *ibid.*, 736, and the cases grouped in Hindmarch, pp. 77–102.)

Indeed, the author whose treatise we have cited last, asserts with much emphasis, that it is the art, and nothing else, which is the characteristic subject of every privilege granted by a patent under the statute. — p. 92. And it may be noted as not without

interest, that in just accordance with the spirit of the English law cases, the English patents of Cooke and Wheatstone, Davy and Bain, claim property in the arts for which their mechanical devices are respectively adapted; not, indeed, in so many words, but in language as unequivocal as that employed by Mr. Morse, nor can we see that there is any reason of policy which should deny protection to an art, while extending it to the machinery or processes which the art teaches, employs, and makes useful. Why should the type, or the ink-ball, or the press itself be dignified beyond the art to which they minister in such humble subordination, and without which they are rubbish? Will you patent the new product, and the new elemental means, and the new process by which they act, and then debate whether you may patent the art? You have patented it already.

We are aware, of course, that it has been held in some cases, under the English patent law, that the art to be patented must have some reference to a manufacture. (See Hindmarch *ut supra.*) But while such a deduction might be legitimate from the words of the statute of James, it would be obviously otherwise under the more liberal phraseology of an act of Congress. And even in England, it must be apparent to every one who has watched the progress of this patent system, that this limitation is practically disregarded already, and that it is to be repudiated as soon as it shall interfere with the protection of an important invention.

Yet in truth there are few discoveries of practical moment to the daily concerns of men, even in the lapse of many years, that are not more or less directly connected with some department of manufacturing industry or skill. The convex lens, the steamboat, the iron road on which cars are propelled by the friction of driving-wheels, — some of these may be so indirectly connected with manufactures, or rather they are associated so intimately with the leading pursuits and interests and enjoyments of all of us, as to make it difficult to refer them to the category of a particular manufacture. Would it not be strange if, on this account, they were excluded from the benefits of the patent system? If we go back to the early story of our race, and mark the stages of its long and difficult advance, — from language, the first exponent of thought, to letters, its first record, — and from letters to printing,

which first diffused letters widely though slowly among men, — and from printing to the telegraph, the electric register of thought, spreading its fibres of sympathy over the intelligent world, and making it throb simultaneously everywhere, as with the pulsations of one heart; who will say that each transition between these great epochs, that signalize the moral and intellectual progress of mankind, should not be marked by a memorial as stately as the first clipping of a cut nail, or the compounding of a new variety of liquid blacking? or that the men to whom we owe them should not be dealt with as liberally, or at least as justly, by the State?

2. The second general subject of Mr. Morse's patent of 1840 includes many particulars, all of them interesting and valuable in their connection with the claim we have just been considering. Taken together, they give a practical form to his leading invention, and guard it from the imputation of being a mere abstract notion, a principle resting in idea. Taken singly, some of them appear to us to be new, as his alphabet (*claim* 5), his combined series (*claim* 4), by which the electric current from one battery, before entirely expending itself in its lengthened circuit, is made to set another battery in action, from which another circuit traverses to a battery still beyond, and so onwards; his adaptation of clock-work to the recording cylinders (*claim* 2); others, again, are only new as they are elements of a novel combination. There is no proof before us that any of the devices which Mr. Morse has claimed in his patent, whether as independent inventions or part of a combination, are not really his so far as he has claimed them. It is unnecessary to claim them in detail, for they are all substantially protected as appliances of the art, which is the great subject of his patent.

II. The second patent of Mr. Morse is for what has been termed his Local Circuit. To understand the questions which arise upon this, it is necessary to refer back to the apparatus which he had patented before, and to explain in general terms its principle and modes of operation. I shall attempt to do this in popular language, and without stopping to consider very carefully the varying niceties of scientific nomenclature.

It is well known that a current of galvanic electricity, while passing along a wire that has been wound spirally round a bar of soft

iron, communicates to the iron a certain degree of magnetic virtue, and that the iron loses this magnetic character again as soon as the electricity ceases to pass along the wire that surrounds it. It is also well known that the electric fluid may be passed along a wire of great length, and yet retain, even at the farthest extremity of the wire, a sufficient degree of energy to impart this occasional magnetism to the iron, and to make it capable for the time of attracting any small body of iron that may be near it. If such a small body of iron be made to form the extremity of a nicely-balanced lever, it is plain that while the one extremity of the lever is attracted towards the temporary magnet, the other extremity will be moved in the opposite direction; and if to this other extremity we affix a pencil or stylus, this will press upon whatever surface may be interposed in the way of its motion, and may either mark the surface, or, if it be of a yielding nature, indent it. It is plain, also, that when the bar of soft iron ceases to be magnetic, in consequence of the electric fluid ceasing to pass round it, the lever will take its original position, and the stylus ceases to press upon the resisting surface.

If, now, we suppose that surface to be moved uniformly below the stylus, it is obvious that the surface will be marked with a straight line, and that this marked line will be intercepted during any intermission of the electric current, so as to form a broken series of straight lines; or, if the electric current passes and intermits, in rapid alternation, a series of dots or points. These broken traces of the stylus, the lines and dots, constitute the *alphabet* of Mr. Morse; a certain succession of either, or a certain combination of the two, being arbitrarily chosen to indicate a particular letter.

The galvanic battery generates the electric fluid continuously, whenever the two extremes, or poles of the battery are connected by a suitable conducting medium, — such as a metallic wire, water, or the earth itself, — along which *conductor*, as it is called, the electric fluid may pass between one pole of the battery and the other, thus performing what is termed an *electric circuit.*

Let us now extend a continuous wire from one of the poles of the galvanic battery to a distant point, taking care that it shall not be intermediately in contact with the earth or with any other good conductor of electricity, and let us at the distant point pass

the wire in a spiral coil round a bar of soft iron, and thence lead it back again to the other pole of the battery, or avail ourselves of the earth itself as a part of the circuit. It is obvious, from what we have said before, that the electric fluid, passing from the battery along the wire, around the occasional magnet, and back to the battery, and then, at appropriate intervals of time, interrupted at its circuit, will cause the stylus to make its trace of lines or dots, or, in other words, its alphabetical record, at the distant station.

It only remains, then, to devise a mode of interrupting and renewing, at pleasure, the flow of electricity, — *breaking and closing the circuit*, in the language of the experts. This is done by dividing the wire, near the battery, and then arranging a simple finger-key, which, when struck or pressed upon by the finger, brings a short metallic conductor into intimate contact with the two ends of the divided wire, and thus restores the continuity of the circuit, while the pressure continues on the key. This may serve as a rude explanation of Mr. Morse's Electro-Magnetic Telegraph, in its simplest form.

It was found, however, at an early period, that though the electric current was still appreciable after it had passed over a great length of wire, yet in traversing the very long circuits that were required to include distant telegraph stations, it ceased to impart a sufficient degree of energy to the temporary magnet to work the stylus effectively. To meet this difficulty Mr. Morse resorted to the simple device of employing a series of batteries, distributed over his line of telegraphic communication, with as many shorter circuits, each operating by means of a magnet at its extremity, to control the movements of a small lever, that opened or closed the circuit of the battery beyond. The last battery gave efficiency to the recording apparatus at the distant station. This formed the *combined series* of Mr. Morse's first patent.

It is easy to see, that the intermediate magnets of the combined series, besides opening and closing the circuits, might be also made to act as recording magnets, by merely adapting to them the stylus, with its appendages; and there would thus be as many stations of telegraphic communication as there were batteries and minor circuits. But there still remained this objection to the combined series, that it could only be worked in one direction, and it was

necessary, therefore, to have two complete lines of wires, with their batteries and magnets, in order to establish a reciprocal communication.

To dispense with this duplication of machinery and expense was the object of Mr. Morse, in the invention which is the subject of his second patent. It had been found that the magnetism, excited by the electric coil, was capable, at the end of an almost indefinitely extended circuit, of giving motion to a delicately adjusted lever, but that this was the apparent limit of its dynamic power. A single wire might be employed, then, without intervening magnets, by connecting it at the extremities with electro-magnets of great sensibility of mechanism, and employing the force of those magnets merely to open short local circuits, from which local circuits the degree of magnetic energy, adequate to the purpose of the recording apparatus, could be derived.

It is found, however, that the magnetism induced in soft iron by the electric current, though truly occasional, does not absolutely cease at the instant of breaking the circuit, but seems to linger in the iron for an appreciable interval of time afterwards, with an intensity which, though slight, bears an apparent relation to the intensity of the current that induced it. This would interfere greatly with the very rapid operation of the telegraph, if the lever were left to withdraw itself from the magnet, to which it serves as armature, by the force of gravity alone. A small compensation spring is therefore connected with the machine, of sufficient strength to overcome the attraction of this lingering or continuous magnetic force, but not sufficient to resist the attraction of the magnet, when the circuit is closed.

But the electric current, after passing over a long wire, does not exert a uniform dynamic energy. However carefully insulated at first, the wire becomes, after a time, more or less exposed to atmospheric action, and the fluid is more or less dissipated in consequence. The posts on which it is supported become conductors during storms of rain, and carry off the fluid to the earth. Under other circumstances, the electro-magnetic phenomena are exaggerated at the receiving station, by atmospheric electricity from the regions through which the conducting wire has passed. The batteries, too, do not always generate the fluid with the same rapidity. In a word the current at the extremity of the circuit is irregular.

Then, it is apparent, that under these varying states of the magnetic energy the adjustment of the compensating spring at the receiving station must not be uniform. If its tension were just that which would neutralize or barely overcome the continuous magnetism induced by an electric current of small intensity, it would not draw back the armature when the inducing current had been in greater force; and on the other hand, a stronger spring adapted to the case of a powerful current, would oppose controlling resistance to the magnetism induced by a feeble one. The *Adjustable Receiving Magnet*, described in Mr. Morse's second patent, meets perfectly the conditions of this difficulty, and enables the operator, by the mere touch of a finger on an adjusting screw, to regulate the tension of the spring, and adapt his apparatus to the circumstances of the moment.

The main line thus arranged, with its delicate receiving magnet and its short recording circuit at each extremity, made no pro vision for intermediate or collateral stations. But, as it had been found desirable in practice to distribute the batteries, in which the electric fluid was generated, over different parts of the line, so as to reinforce the energies of the current in its progress, it was almost an obvious suggestion to connect at these several points a receiving magnet of adjustable character, either with the main line or with the battery forming part of it, and to attach to this receiving magnet a local registering circuit, or a branch circuit leading to one or more collateral stations.

Such I understand to be Mr. Morse's *Local* or *Independent Circuit*. His patent of 1856, as reissued in 1848, claims it in these words: "The employment in a certain telegraphic circuit of a device, or contrivance, called the receiving magnet, in combination with a short local independent circuit or circuits, each having a register and registering magnet, or other magnetic contrivances for registering, and sustaining such a relation to the registering magnet or other magnetic contrivances for registering, and to the length of circuit of telegraphic line, as will enable me to obtain, with the aid of a main galvanic battery and circuit, and the intervention of a local battery and circuit, such motion or power for registering as could not be obtained otherwise without the use of a much larger galvanic battery, if at all.

That the local or independent circuit, as we have described it, and as it is more accurately and perhaps more intelligibly set out by Mr. Morse in his specification, was original with him, cannot be seriously questioned. The devices referred to in the patents of Cooke and Wheatstone, and Davy, are at least imperfect modifications of the combined series of Morse's first patent; one of them not improbably borrowed from it. The adjustable receiving magnet, the indispensable and characteristic element of the local circuit patent, no one has claimed but himself.

It is only to make the first approach to a controversy on this point, to prove to us that Professor Henry had as early as 1828 made the *intensity magnet*, with which the scientific world is now familiar, — or that he afterwards, and before Mr. Morse's first application for a patent, had illustrated before his classes, at Princeton, the manner in which one circuit could operate to hold another closed, or to break it at pleasure, — or that he had foreseen the applicability of his discoveries for the purposes of a telegraph.

The question is not one of scientific precedence; and if it were, this is not the forum that could add to or detract from the eminent fame of Mr. Henry. It is purely a question of invention, applied in a practical form to a specific use, and so regarded, it admits of but a single answer.

In passing from the questions of originality and identity of invention that have been raised in the land, without a more detailed review of all the testimony, there is reason perhaps for an explanatory remark. It is this; the decree of a judge finds its appropriate and only justification in the facts proved before him, not in theories, however ingenious, nor the less speculative influences of other minds; and where the essential facts of a case are as clearly established as they are here, it would be unprofitable as well as painful, perhaps, to discuss the particulars of variance between the witnesses.

There is no place in which the evidence of scientific men, upon topics within their own departments of knowledge, is more to be desired than in this court, when sitting for the trial of patent causes; and the opinions, also of such men, when duly supported by reasonings founded on ascertained fact, must of course be valued highly. But it is a mistake to suppose that, even on a

question of science, opinion can be dignified here or elsewhere with the mantle of authority. Still less can we allow it to avail us here, when it assumes contested facts, or volunteers to aid us in determining the import of written instruments.

These remarks are not dictated by a spirit of unkind or uncourteous commentary on the depositions before us. We know that when opinion is active, it is not always easy to limit its range. There is besides very much of accurate scientific history, and of just and well guarded deduction from it in these volumes of exhibits. But it must be confessed also,that there is to be found here and there not a little of imperfectly considered dogma, as well as something of doubtfully regulated memory—and it has seemed to us, in this case as well as in others, that the toil and expense and excitement of litigation might have been moderated, perhaps, if the appropriate tone and province of testimony had been more exactly understood by some of the witnesses.

The objections which have been taken to the terms of the reissue of Mr. Morse's patent in 1846, may be answered by a simple reference to that part of our opinion in which we have considered the arguments of the same character that were urged against the patent of 1840.

It is beyond controversy that the local circuit patent has been infringed upon at some of the stations of the respondent's line, and it is the opinion of the court that it is also violated whenever the branch circuit of Mr. Rogers is employed. We have not been able to see the asserted difference in principle between the two devices Both are equally well described as branch or as local circuits They have the same purpose; they effect it by the same instrumentality, even in appearance, to a great degree, and they seem to vary only, in this, that the one derives its electric fluid from a battery placed within the line of the main circuit, and the other from a battery placed without it. The change may be for the better, or it may not; if it be, it is patentable as an improvement, but it cannot be used without Mr. Morse's license, until after his patent has expired.

III. The third patent is for the chemical telegraph. We do not propose to enter on the discussion of this. The subject of it is clearly within the original patent of Mr. Morse, if we have cor-

rectly apprehended the legal interpretation and effect of that instrument. We will only say, that we do not hold it to have been invalidated by the decision of the learned chief justice of the district of Columbia, on the question of interference. The forms of the two machines before him were not the same; and the leading principle of both having been already appropriated and secured by the magnetic telegraph patent of 1840, nothing remained but form to be the subject of interference.

The counsel for the complainants will be pleased to prepare, for the consideration of the court, the draft of a decree in accordance with the prayer of their bill.

Extract from the decision of Justice Woodbury, United States Circuit Court, District of Massachusetts, 1850.

Among the sixty-two competitors for the discovery of the electric telegraph by 1838 (as computed in *Channing's* Ev., 41, a), Morse alone, in 1837, seems to have reached the most perfect result desirable for public and practical use. (R. 6, Morse Ev., 128–9, r.) This may not have been ccomplished so wholly by the invention of much that was entirely new as by "improvements," to use the language of his patent, on what had already been done on the same subject, *improvements*, ingenious, useful and valuable. By the needle, or lever instead, not only deflected by the magnet, but provided with a pen to write, or in other words, a pin at the end to make a dot or stroke; — when thus deflected, as the circuit was held longer closed or broken, with machinery to keep the paper moving in the mean time, and so as to inscribe the dots and lines separately, and more especially with an alphabet, invented and matured, assigning letters and figures to these dots and lines according to their number and combination, he accomplished the last desideratum. (1 Renwick's Ev., 235.) Thus the fortunate idea was at last formed and announced which enabled the dead machine to move and speak intelligibly at any distance, with lightning speed.

It will be seen, that amidst all these efforts at telegraphic communication by electricity and electro-magnetism, more or less successful from 1745 to 1838, none had fully attained to what Morse accomplished.

Some had succeeded in sending information by signals, even beyond the decomposition of water and the deflection of the needle. They had made persons at a distance recognize the sign used, and thus obtain intelligence. They had also made marks at a distance. *But in no way does it appear that they had sent information at a distance, and at the same moment, by the same machine, traced down and recorded it permanently and intelligibly and quickly.* This triumph was reserved to Morse's inflexible perseverance in experiments and close observation; and chiefly after arming the end of the needle or lever with a pin, by use of a roller with appropriate machinery to move his paper, so as to trace successive dots and marks, and by a stenographic alphabet to explain the marks made on the paper, *and by more power through his combined circuits, to effect all at a greater distance, and with greater despatch.* (Gale's Ev., 123, r.)

Afterwards, by the improvements in batteries by Daniell and Grove in 1843, he was enabled, with these local circuits, to increase the power of the electro-magnet so as to accomplish this at a distance, and with a speed and economy which rendered the invention applicable to general use. (Jackson's Ev., 166.)

Before 1843, Hare's battery was used, and was too feeble (Jackson's Ev., 164, v.; Channing's Ev., 45, v), and before that, Cruikshank's. The want of this increased power had rendered former attempts at times abortive for practical purposes, and its being recently supplied by the science of Faraday and Henry, tended more speedily, by Daniell and Grove's battery, founded on them, to remove the greatest obstacle to success. (Davis' Manual, p. 125; Silliman's Ev., 95, v; Jackson, 166.)

Others had before, and about the same time, as has been noticed already, made marks on paper at a distance by the deflection of the needle and by sparks, and attached special meanings to them, and the spaces between them.

But the evidence is strong that Morse's, if not the very first in these respects, was the most perfect and available for practical use, and the improvements by others in batteries came very opportunely to aid in its power for distant operations, beyond what even the local circuits had done. (Prof. Silliman's Ev., 96, a.) This special advance beyond all others, except some new combination,

looks as if chiefly mechanical, but still it sufficed to promote the desired object.

By them and his new combinations, he was going a step farther than any of his predecessors, for practical use, had accomplished; and this entitles him to protection and the fame he has achieved.

This he and his assignees can therefore protect, but not particulars known long before him, or which he neither claimed nor described, nor invented. As before explained, he must not be considered to have claimed the invention of the general principle or art of telegraphing by electro-magnetism, nor could he, as already shown, have protected it if he had. But all he clearly claimed was a "method" of doing it, "an improvement" in doing it, and these he has a right to protect, and these only. They were the pen to mark or trace in the end of his lever or needle a happy thought, but the movement of the paper on the roller was almost as necessary to receive marks in succession, and his alphabet to be thus applied and used was the crowning act of his invention. (Renwick Ev., 244, p.)